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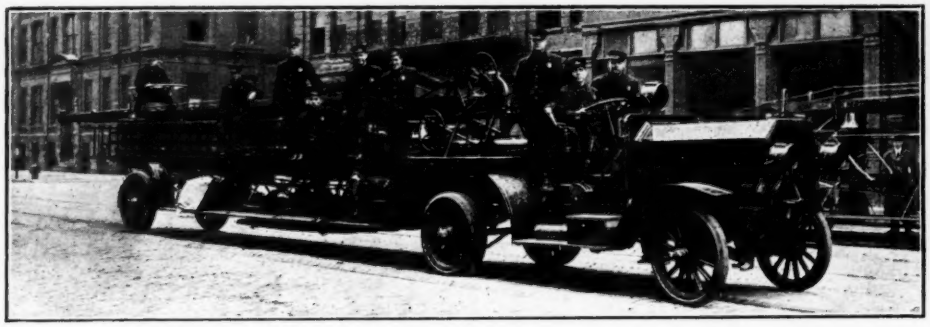

SEAGRAVE TRACTOR *in use in Cleveland, Ohio, drawing large ladder truck.*

VOL. XLV. OCTOBER, 1913. No. 4.

New theories are being advanced in the engineering world each week, month and year; some are of fundamental importance, others are strengthening weak links in the chains of discoveries, all are of vital interest. The man who is alive and keen to the possibilities of applying the evolutions of many minds to his own ends is the person whose advancement becomes the envy of those less progressive. Look at the libraries of men of achievement; you will find they contain large files of periodicals devoted to their fields of work. These publications keep them in every-day touch with important developments. MUNICIPAL ENGINEERING *is the authority in its field; it keeps those interested in the subjects covered by it in intimate contact with every vital happening.*

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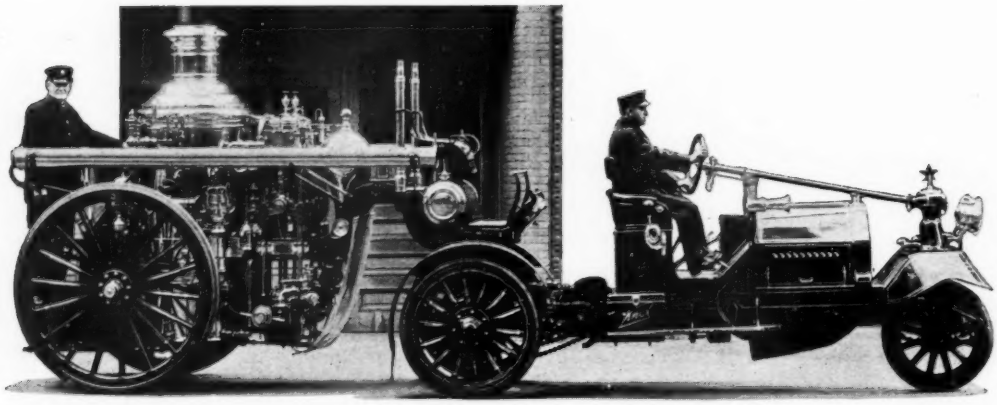


KNOX MARTIN TRACTOR *used in Springfield, Mass., to convert a horse-drawn steam engine into a motor-driven apparatus.*

CARE of MOTOR DRIVEN FIRE APPARATUS

by
J. M. TAYLOR,
Springfield (Mass.) Fire Department.

The following article has been given the first award in the contest inaugurated by this publication on the subject indicated by the above title. Mr. Taylor has given a very thorough description of the maintenance of motor apparatus, both electric and gasoline driven. The announcement of other prize winners will be found elsewhere in this number.

THE matter of care of motor fire apparatus in the Springfield Fire Department is rendered somewhat long and involved in explanation because of the fact that two totally different types of machines are used; namely, the electric storage battery and the gasoline. The former requires much more precision and attention to detail in its handling and care than does the latter, owing to the many details in which there must be perfect co-ordination. For that reason, as well as because the electric storage battery type of machine is not so familiar to many persons as is the gasoline, it will be well to treat with the electric type and its care first.

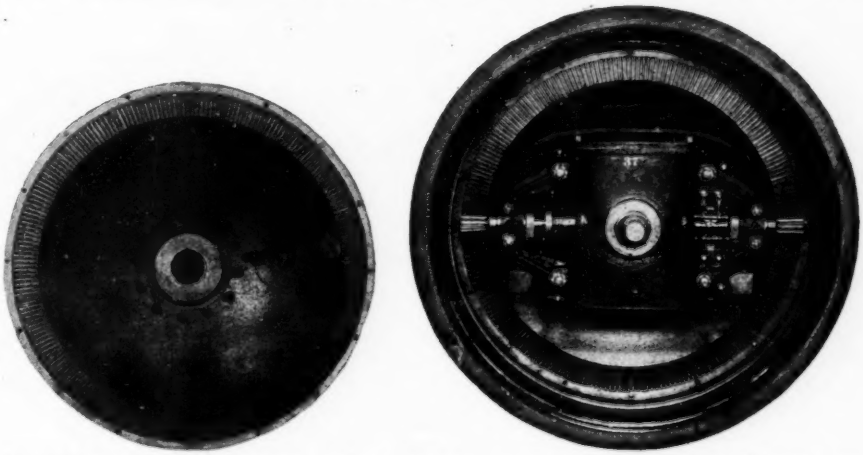
The five electric machines in use in this city are all equipped with the Couple-Gear wheels and are four-wheel drive. These wheels are peculiar in that their power is transmitted on the rims instead of on the hubs, the wheels being so constructed as to look like solid disks, altho in reality they are hollow metal boxes. Each wheel contains an armature, field coils, commutators and brushes, thus making the care of each wheel equal to that of an electric vehicle of the ordinary type, which in reality each wheel is. For every wheel is totally independent and is fitted with a fuse which will allow for the cutting out of one or more in case of an emergency, the vehicle then being pro-

pelled by the remaining wheels. This is made possible by the fact that the wheels are built to stand overload enough so that the cutting out of one or more will do no damage by overstraining the remaining wheels.

CARE *of the motor wheels is the important consideration in electrically-driven apparatus.*

Naturally the wheels form a very important part of the care of the apparatus and one of the most important items of their care is to be at all times certain that all connections are absolutely tight. Furthermore, they are practically air-tight and, because of lack of ventilation in them, moisture is bound to form to some extent inside. Then dust particles from the carbon brushes will mix with the moisture and adhere to the commutator, gumming it. The effects are two. First, when the armature becomes gummed the contact in the wheel becomes poorer with a resultant loss of power. Second, the accumulation of the gummed dust particles will cause excessive sparking, which will burn or score the commutator, which, in turn, adds still more to the sparking. If this is allowed to continue the commutators must eventually be removed and turned down to get a new surface. Therefore, it has been found necessary here to carefully clean the interior of the wheels after every third run when, if the commutator shows signs of scoring, it is smoothed with 00 grade sand paper. At this time, also, the connections are gone over and carefully tightened, for one loose connection will put a wheel out of service. Thus, the two essentials in the care of the wheels have been found to be absolutely tight connections and cleanliness, meaning a total absence of all foreign substances such as dust or dirt of any nature.

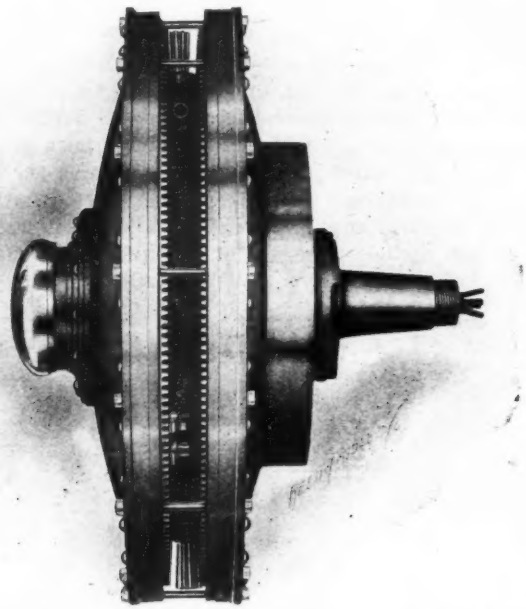
The National lead batteries are used in all the machines, being 80-cell, 17-plate batteries with a full charge power of 2½ volts per cell. They must be charged by a direct current, and as a 500-volt alternating current comes to the stations, it must be changed to a 250-volt direct current by means of a rectifier or reostat. In three stations a mercury rectifier is used, while the other two, which are equipped with electric apparatus, use reostats. In the matter of the batteries and their charging it must be borne in mind that the batteries are never entirely run out, a practice which tends to injure the battery. Therefore great care must be taken in their handling and charging.



VIEW *of Couple-Gear motor wheel showing front disk and side of motor removed, giving access to the armature, field coils and bearings.*

The batteries are recharged after seven average runs, at which time they are usually about half exhausted. At this time the plates are carefully looked after. These plates should never be allowed to become dry where their ends are near

the surface of the solution, but should always be covered by about half an inch of liquid. Therefore, if it is found that some of the plates have become exposed they are covered to a depth of half an inch with distilled water. Then, when the charging takes place, the water will mix with the solution, but it will begin soon after to rise gradually to the top. This is to be desired, for in this way it is the water and not the solution which is lost by evaporation or gasing. In case of sloppage, however, the jars are refilled with electrolyte instead of water, the electrolyte being 1,300 test.



TIRE *and band removed from Couple-Gear motor, showing relative position of the two pinions.*

In batteries, such as these, which are never totally exhausted, great care must be taken to prevent sulphation. If the batteries remain inactive for a period of several days sulphation will set in, and constant hydrometer tests are taken to prevent and guard against this occurrence. When the specific gravity of the solution begins to fall it is known that sulphation has set in and the machines are treated with what is known as an enlivening charge. That is, a very light charge is run into the batteries and is repeated at a later interval if the period of inactivity continues. There is great danger in this process, however, for unless care is used the batteries will be overcharged, and, to guard against overcharging, the solution during charging is frequently tested with the hydrometer. The only real cure for sulphation is use of the batteries, the enlivening charges being really little more than a staving off of the injurious process for a brief while in the hope of the machines being called into service. If sulphation advances, the batteries must be taken apart and treated. Because of the danger of sulphation electric storage battery fire apparatus is of very little value in any station where it will not receive an average of two or more runs a week.

As in the wheels, the connections of the batteries must be given considerable care, for one burnt-out connection will put half the battery out of service. The connections, furthermore, must be kept covered with vaseline in order to avoid the corroding action of the gases and acid of the solution. Likewise, as in the wheels, no dust or foreign substances must be allowed to get inside the battery covers.

When the battery reaches a point where its action shows it to be deteriorating fast, the life of it can be prolonged by having it taken out and overhauled, and by putting in new separators. The expense of this is small, and, as it prolongs the life of the battery from six to eight months, it pays to do it.

The same rule holds with the controllers as with everything else in the mechanism of these machines; their parts must be kept tight. If this is not done a flash at

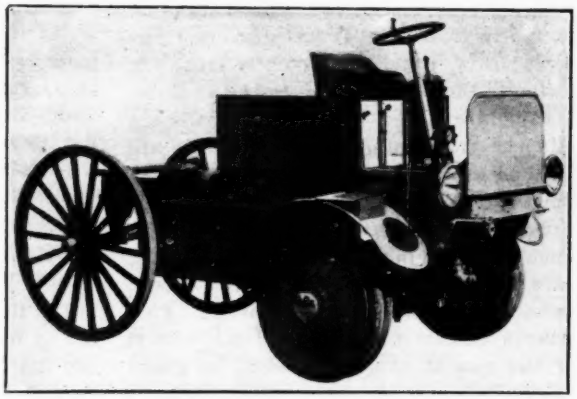
a loose finger will burn off the finger or will score the plate, requiring both a new finger and a new plate. On the other hand, too much tension will cause binding, which, if followed by too great pressure, will cause a buckling under that will burn out the entire controller. To guard against this, a very thin coating of vaseline should be kept on all parts of contact of the controller. Proper adjustment in the controller means a perfect contact, and in order to keep the adjustments perfect the controller is looked after every time the wheels are gone over, namely, once every three runs.

In the care of the gasoline apparatus in this department there is a wealth of detail which, though not as involved as that of the electric, is equally important in the maintenance of complete efficiency. There are, of course, rules governing the entire care of the apparatus, but in addition to the rules it has been found very beneficial to discover the men best suited for caring for the apparatus and to put the work in their hands so far as may be possible. Rules governing the care of apparatus may be found in every station where motor apparatus is used in any department, but it has been the experience of this department that much more is necessary in the care of motor apparatus than a strict observance of rules. Much depends on the men in charge.

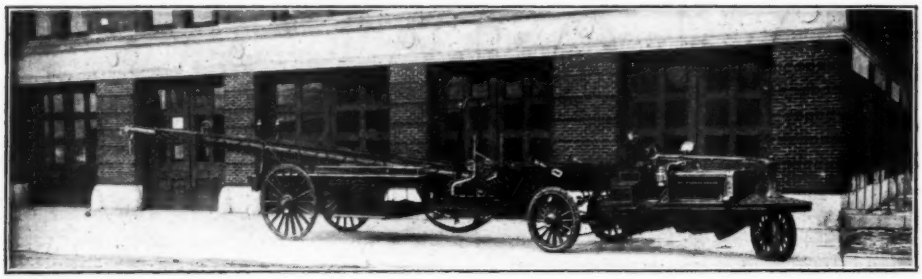
The rules for this department require that all motors shall be started at nine o'clock every morning and nine o'clock every night, at which time the engines and gasoline supply pipes are inspected. Furthermore, the captains must inspect all parts of the apparatus once each month and see that all nuts are tightened and properly locked; that chains are greased and grease cups filled; that the water in the radiators is changed and clean water run through pump and jackets; that all batteries and spark coils are tested; that spark-plugs are cleaned; that there is the required air pressure in pneumatic tires, plenty of oil in reservoirs and sufficient grease on wheel bearings; that the rear wheels are jacked up and grease worked into the transmission; that the wheels, steering gear and all other parts are properly adjusted; that the mud pan is removed and the under side of engine cleaned; that the frame, wheels and steering gear are touched up with paint and the mud pan, fenders, mufflers, and other exposed parts blackened, if needed.

Those are the rules, sufficient, it would surely seem, to cover every possible phase of the care of motor apparatus and to insure the condition of the machines. But the rules alone are not sufficient for this purpose. There are numerous things beside which have been found necessary, things which only long experience with motor apparatus could teach. For instance, there is an unwritten rule, but none the less binding for that fact, that the gasoline tanks shall never be allowed to get more than five gallons under capacity. Also, after about every five hundred miles of running, all the oil is drained off, the reservoirs and pipes are thoroughly cleaned and the oil replaced with fresh oil. This gets rid of the grit which is caused by friction in the mechanism.

One thing which this department has learned by dear experience is that great care should be taken in the quality of the gasoline which is used. All gasoline in use here now is carefully tested with a hydrometer when it is delivered at the stations and unless it tests 64 or better it



ELECTRIC TRACTOR *used in Springfield, Mass., for motorizing apparatus which has heretofore been horse-drawn. Tractor manufactured by the Couple-Gear Freight Wheel Co., Grand Rapids, Mich.*



HORSE-DRAWN *water tower converted to motor apparatus by connecting a Knox-Martin tractor.*

will not be accepted. It has been found that the quality of the average gasoline which is being sold is growing steadily poorer and that unless this matter is carefully watched the department will be loaded up with inferior gasoline to the detriment of its efficiency. High grade gasoline will start quicker and warm up quicker, which in cold weather will save many seconds, perhaps minutes. It costs but a fraction more, and its superior value more than pays the difference in the price.

EXPERIENCE *has proved that it is best to keep motors operating at slow speed during freezing weather when cars are at fires.*

In freezing weather the engines are always left running at low speed when at a fire, it being found that this is the only way to prevent them freezing. This department has tried alcohol in the water which cooled the engine, and the engine promptly froze up. It has also used air-cooled cars, which as promptly froze up, owing to the congealing of the oil in them.

In cold weather, or when the roads are slippery from rain, anti-skid devices are used on all wheels, whether equipped with pneumatic or solid tires. Also, on cars fitted with pneumatic tires which are frequently called into service, such as squad cars, chains are always kept on the wheels, being changed about once a month. This guards against possible accidents, and it is the aim of this department to guard against all possible accidents so far as is feasible. In furthering this policy it has been found advisable for the cars to carry a spare gasoline pipe which can be connected quickly to the carbureter, as the pipe in that location occasionally breaks because of the jarring of the machine.

It has been found advisable to center all responsibility for the condition of each machine in the driver, the drivers being changed at intervals so that each efficient man will not be allowed to get out of touch with the work. This centering of responsibility means that the driver must be ever on the alert to discover any little fault in the running of his car. He is not allowed to tinker with it when the car is running in a satisfactory manner, but whenever there is anything wrong he is required to find it and to repair it within the shortest possible time, provided the fault is one which he can remedy. In case of a serious fault or breakage he is required to report the matter at once to the officer in charge of the company, who will then take such steps as may be necessary for the repairing of the broken part.

It has been found here that the whole secret of efficient service from motor apparatus lies in the care which each machine receives while it is in the house. Every little suspicious squeak or knock is hunted up and the cause is remedied as soon as found. In fact, it has been found advisable to treat a machine much as a mother would treat a child, discover its symptoms, then discover the ailment and cure it within the shortest possible time.

The financial saving to be found in the use of motor apparatus is less a comparison than a contrast with horse apparatus. A maintenance sheet was kept in this department during the year ending March 1, 1913. The result was that motor apparatus was found to cost as follows: For the

year; electric, actual maintenance, $52; gasoline, average, $34. As a comparison by individual pieces, Truck 1, electric, cost $52 in maintenance; Truck 8, horse drawn, cost $620.42. Truck 1 made 148 runs during the year, and Truck 8 made 107. The cost of Hose 1, electric, averaged about the same as that of Truck 1, the hose company making 192 runs. Hose 10, horse drawn, cost $427.94 with 143 runs. Of the gasoline cars the lowest cost for the year was $15.61, for 63 runs, made by Hose 13; the highest was $37.40 for 110 runs, made by Hose 8.

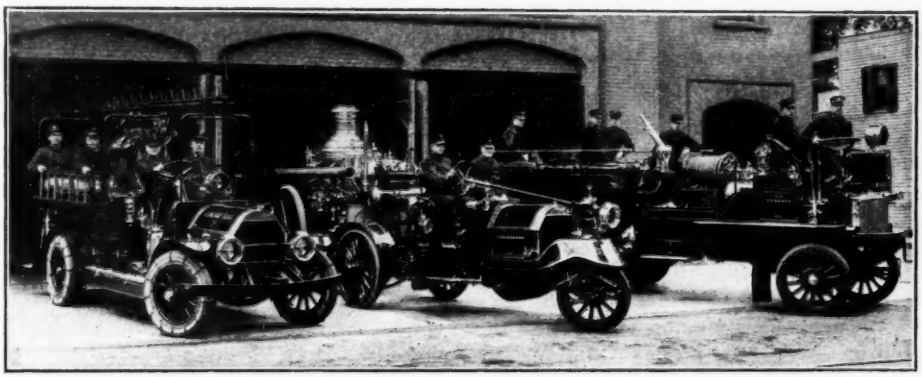
A comparison of the two types of motor apparatus from a standard of care is difficult to make because of the diversity of their points, but there is no parallel whatever between them and horse-drawn apparatus in this line, every advantage lying with the motor apparatus.

There are two recommendations to be made to any city which is going into motor apparatus. This first is to assure the efficiency of the drivers and of the men who will have the care of the motor apparatus. If possible, it is most advisable for a city to engage an instructor and to place the training of the men and the supervision of the apparatus in his hands. This has been done in some of the larger cities with decidedly beenficial results, a practical school for chauffeurs of fire apparatus being established. As a substitute for a school this city has found it practical to place some of its men in a local automobile factory for periods of two weeks or more in order that they may gain practical knowledge of the assembling and manufacture of the machines.

Another suggestion lies in the change from the old practice of keeping lighted lanterns always on the apparatus at night, especially on gasoline apparatus. The burning of the oil lanterns is a constant menace in case gasoline should escape from the tanks or a broken tube, for the flame in the lantern will ignite the gas and cause a resultant explosion and fire.

There is one suggestion concerning a minor matter which has caused more or less trouble to many drivers of motor fire apparatus. It has been discovered here that when the electric siren grows weak, as it does at intervals, the cause does not always lie with the batteries. It will frequently he found at such times that if the motor of the horn is taken out and cleaned the fault will be remedied.

All gasoline machines in service in this department at the present time are Knox machines, including chiefs' cars, auxiliary squad cars, hose wagons and two Martin tractors. The electric ladders were built by the Seagrave Company, the chassis in each case being furnished by the Couple-Gear Freight-Wheel Company. The electric hose wagons are also equipped with a Couple-Gear Freight-Wheel chassis, but their bodies were built in this city according to specifications furnished by this department.



ONE *of the Springfield (Mass.) completely motorized engine companies. Machine on the left is a special squad and life-saving car, the one in the center a steam engine connected to a Knox-Martin tractor, and the one on the right a combination hose and chemical apparatus.*

No men have been actually displaced by the use of motor apparatus, altho each company equipped with a motor piece has in reality gained one man. This fact results from the difference in the mode of propulsion. No driver is required when a motor piece is standing at a fire, for there are no horses to be watched or cared for and no danger of runaways or of positions being changed by restless horses. Therefore, each company gains a man in the person of the driver of the motor piece, who, as soon as the apparatus is stopped, jumps from his seat and takes his place in the company, as a hoseman or ladderman according to the class of the piece which he drives.

The matter of actual saving to be made by motor apparatus over horse-drawn apparatus may be best summed up in the following figures: During the fiscal year of 1912 the department expended more than $9,000 less than was spent during the preceding year. This fact assumes added significance when it is noted that during 1912 the department was increased by 32 men and responded to 100 more alarms than during 1911. Furthermore, although the department is annually increasing the number of men in its manual force, its appropriation for each year is growing less as its horses and horse-drawn apparatus are being done away with.

There has been no desire in this department to decrease the number of stations. Our stations are situated where they are needed and any attempt to reduce their number would be extremely detrimental to the fire service. Also, as this city is growing with great rapidity, the call is for more rather than fewer stations. There is this point to be considered in the present condition of our stations, however. All our men now sleep in individual rooms which are as large as those to be found in ordinary hotels, and they have also splendid equipment for their general comfort such as lounging rooms, shower baths, etc. All our new stations are built with these accommodations, but these things also exist in the old stations. Where the horses have been done away with the portions of the buildings which were formerly used for feed lofts, forage bins and storage places for the innumerable bits of horse paraphernalia have been torn out and replaced with comfortable single rooms for the men. Large lavatories with shower baths and set bowls occupy places which were formerly given over to forage and rats, and a general toning up of the stations has resulted.

LARGE *savings are being effected in the building of fire stations for motor cars in place of horse apparatus.*

In the matter of stations lies a strong feature which illustrates the saving of motor over horse apparatus. A station built to house motor apparatus does not need to be nearly so large as one built for horse apparatus, even tho comfortable arrangements are made for the housing of the men. Here, in these days of the high cost of building materials, lies a tremendous saving.

Perhaps the best illustration of all of the superior efficiency of motor apparatus over horse-drawn is to be found in the experience of this city on the Fourth of July just passed when we suffered an epidemic of small fires. The total mileage covered by Headquarters at that time was 50 miles with the thermometer well above 90 all the time. All the fires were put out in short order and without any serious loss. But what would have been the result had horses been required to cover those fifty miles in a temperature of more than 90?

RESULTS OF GARBAGE REDUCTION

AT COLUMBUS, OHIO.

Hundreds of Cities Are Grappling With the Garbage Disposal Problem. Shall They Continue to Allow Contractors to Pocket Profits Which Rightfully Belong to the Municipality? Columbus Has Solved This Problem to Its Profit.

THE municipal garbage reduction plant at Columbus, O., has been in operation since July, 1910, and is now in full working order. It was designed by Irwin S. Osborn, who was in charge of the construction of the plant and has operated it up to the present date. Mr. Osborn is now on a tour of observation of foreign garbage disposal plants and on his return will go to Toronto, Ont., to take charge of the municipal garbage plant, where he will doubtless repeat his Columbus success.

The plant was fully described in MUNICIPAL ENGINEERING, vol. xl, page 322, and the following brief description is given to show what changes have been made to improve the operation.

The reduction plant consists of five buildings: Unloading building, reduction building, percolating building, office and stable.

The unloading building is 45 feet wide by 85 feet long with elevated railway tracks extending thru it. It is used for the unloading and sorting of all garbage delivered at the plant.

The reduction building, which is 80 feet wide by 167 feet long, contains the reduction machinery, including digesters, presses, grease separating tanks, refining and storage tanks, drying equipment, screens and evaporators. It also contains the boiler plant, machine shop and water supply pumps. The part containing the digesters, presses, dryers and storage rooms is three stories high and the other part one story high.

The percolating building is 40 feet wide and 46 feet long and contains percolators for extracting grease, refining and distilling tanks for recovery of gasoline. All buildings except office and stable are constructed fire-proof of steel, concrete and brick.

The garbage when delivered at the plant is weighed on railway scales and then run into the unloading building. The body of the car is then turned on trunnions by means of power hoists and the contents are discharged on the floor below. The free water is drained off thru gutters, covered with perforated plates which extend full length of the building. The water from gutter is drained into catch basins from which it can be discharged into the grease separating tanks, after which it is evaporated.

The garbage is placed in a scraper conveyor, which extends the length of unloading building, thence thru housed truss to top floor of reduction building, and discharges directly into tops of the digesters thru swivel spouts.

The digesters are eight in number, 7 feet in diameter and 14 feet long, constructed with dished head and cone bottom. The capacity of each digester is 10 to 12 tons. The digesters are arranged in nests of four and connected to common receiving hopper by large gate valve and nozzle on the bottom of each digester.

The digesters when filled are sealed and steam is admitted at the bottom for cooking. The time required varies with the quality of garbage during the different seasons of the year. Any odors or gases escaping from the digesters are passed thru condensers and the insoluble gases thru deodorizing furnaces. When cooked the garbage is discharged from digesters into receiving hopper which is directly connected with an Edgerton roller press. The material as it passes thru the presses discharges the solids at the front into a scraper conveyor and the grease and water flow from rear of presses thru conduit into catch basins in the grease separating room.

METHOD OF HANDLING GREASE.

The water and grease are pumped from catch basins into a battery of tanks where the grease is separated by gravity. The grease is drawn off into treating tanks, from which it is pumped to a triple-effect evaporator and concentrated to a syrup so as to recover the solids in solution. The syrup or concentrated water is pumped to a storage tank on second floor of the drying room.

The conveyor from the roller presses discharges the solids onto the second floor over the dryers, and then feeds into one or two continuous dryers of the direct heat type. The dry material is elevated and discharged into conveyor which conveys the material to the percolating building.

The material in the percolating building is stored in large hopper with feeding spout fitted with undercut gates. The percolator is of the revolving type and charged from storage hopper above. The percolator holds approximately 10 tons per charge. When filled the percolator is sealed and flooded with gasoline. The gasoline acting as a solvent united with the grease and the combined gasoline and grease is drawn off at the bottom and discharged into distilling tanks. After the grease combined with the gasoline is extracted the material is still wet with gasoline. In order to recover the gasoline and dry the material, live steam is passed thru the material and the gasoline passes off as vapor thru vapor line connected with condenser, where it is condensed and returned to storage for future use.

The combined grease and gasoline drawn from the percolator is heated so as to vaporize the gasoline, which in turn is carried thru vapor line to condenser and recovered. The condensed gasoline and steam from the condenser flows thru pipe to storage tanks where the water is automatically separated and gasoline is again ready for use. The grease after distilling off the gasoline is pumped into storage tanks ready for shipment.

The tankage or dry material after treatment is discharged from the percolator and conveyed back to second floor of drying building, where it is screened to remove rubbish or foreign material.

The tankage from screen is then mixed with the concentrated tank water recovered in the evaporator and then passed thru the dryer so that all the solids originally contained in the garbage are combined in a dry state. After final drying the material is elevated to storage or loaded into cars for shipment.

CHANGES WHICH DOUBLED THE DRYING CAPACITY.

During 1912 the drying equipment was changed from steam dryers to direct heat dryers for drying all material. This work consisted in the removal of two vacuum mixing dryers, the installation of one new direct-heat dryer with necessary furnaces and chambers and the rebuilding of the revolving steam dryer. The drying equipment was changed by the contractor who made the original installation, to complete the contract, and the city was put to the additional expense of constructing foundations and the labor required in rebuilding the revolving steam dryer. The changes made resulted in doubling the capacity of drying equipment and permit the drying of all material during the day shift of eight hours. It also permits the drying of material at less cost for labor, fuel and supplies. In connection with changes in dryers, tests were made in treatment of off gases and methods were developed for deodorizing them. Deodorizing condensers are now being in-

stalled and provision made for deodorizing all gases in high temperature furnaces.

PERCOLATING PLANT INCREASED GREASE YIELD 40 PER CENT.

The addition of the percolating plant, which was placed in operation during the month of January, 1912, proved a very good investment, very satisfactory results being obtained. Previous to the operation of the percolator the only recovery of grease was made by pressing, so that the material when dry contained approximately 10 per cent. of grease which was not recovered. During the year all solids were percolated and the yield of grease from the plant increased approximately 40 per cent.

The percolating plant was constructed at an approximate cost of $20,000 and during the year 203½ tons of grease was recovered by percolation, valued at $16,890.50. The cost of operating the percolating plant, including fuel, labor, gasoline and supplies, amounted to $4,601.97, making an earning from percolation amounting to $12,288.53, which is about 60 per cent. of the original investment.

During 1912, the amount of garbage reduced was 18,789.47 tons, as compared with 17,534.49 tons in 1911. The average tonnage per day was 60.03 in 1912 and 56.56 in 1911, counting 313 days as the year. In September, 1912, the tonnage reduced was 2,425.47, an average of 93.29 tons per day of operation. In February the average was only 43.45 tons per day.

By months, the average daily tonnage of garbage reduced was as follows:

January	45 tons
February	43 tons
March	45 tons
April	47 tons
May.	51 tons
June	54 tons
July	67 tons
August	85 tons
September	93 tons
October	64 tons
November	62 tons
December	55 tons
Average for the year	60 tons

This table is computed on the assumption that the plant received no garbage on Sunday.

The cost of operation was $38,503.69 for the year, or $2.05 per ton of garbage reduced, as compared with a cost of $1.85 a ton in 1911. Receipts from the products of the plant were $61,728.62, or $3.29 per ton of garbage reduced, as compared with $3.35 in 1911.

Repairs and renewals are charged to operation and a sinking fund charge of 3.36 per cent. on the total cost of $210,000 would extinguish the 4 per cent. bonds when they become due. These capital charges of 7.36 per cent. amount to $15,456 a year. The table of receipts and expenditures with this addition would read as follows:

Expenditures.

	Total	Per cent. of total cost
Supervision and labor	$24,170.86	45.2
Coal	7,442.73	13.4
Electric power	1,305.95	2.4
Repairs and renewals	1,717.73	3.2
Supplies	3,163.09	5.8
Office expenses	181.01	0.3
Chemical analysis	223.00	0.4
Miscellaneous	299.32	0.6
Interest and sinking fund	15,456.00	28.7
Totals	$53,959.69	100.

Receipts from Products.

Grease	$42,559.52	68.9
Tankage	17,537.04	28.4
Hides	1,544.49	2.5
Miscellaneous	87.57	.2
Totals	$61,728.62	100.

The receipts per ton of garbage reduced averaged $3.29. The total expense, including capital charges, was $2.87, leaving a net profit of 42 cents a ton, or $7,768.93 for the year.

Notwithstanding the increase in quantity of grease recovered by the new percolator, the receipts from products were only slightly greater than for the year 1911, the reduction in price at which the products could be sold reducing the total receipts even more than the increase in receipts due to increase in quantity of grease.

MUNICIPAL ASPHALT PLANT

of St. Louis, Mo.

Description and Costs of Operation of a Plant Which Has Made an Efficient Start.

IN the year 1911 the city of St. Louis contracted with Warren Brothers Company, of Boston, Mass., for a plant to prepare material for laying and repairing asphalt pavements which was in successful operation for part of 1911, all of 1912 and is now in daily use.

The plant is under the management of the street department, of which Charles M. Talbert is commissioner, and is under the direct charge of W. L. Hempelmann, the engineer of bituminous roadways of the street department, and O. S. Brighton, the general superintendent of asphalt repairs.

The plant was provided and put in operation by James C. Travilla when he was street commissioner, and the system adopted is largely due to him, although details have been worked out by his subordinates as named. Mr. Talbert was appointed to fill the vacancy caused by the resignation of Mr. Travilla and took his office very nearly at the close of the fiscal year of the city in April, 1912, so that the data given in this article are those of the preceding administration.

The total cost of the asphalt plant, exclusive of the concrete foundations, paid out of a special appropriation of $20,000 in 1911, was $19,875.64. It is located at Kings Highway and Eager Road on ground owned by the water department, and is served by a railroad switch, which accounts probably for its location rather decidedly away from the center of the bituminous streets of the city, although it is not far from the geographical center of the present city area.

A rear view of the plant is given in the photograph, showing the elevators for carrying the materials to the dryers, and the furnace for heating the sand drums. In the house above are the weighing and mixing machinery of the standard Warren plant. The small brick building at the right is the chemical laboratory. The office, storeroom and machine shop are in a building on the left, not shown. A rail of a delivery track shows in the foreground and also a corner of one of the bins for materials.

The layout is such as to make the handling of materials more than usually simple and inexpensive, altho some reductions in daily cost could still be made by expenditures for machinery for unloading and handling materials.

The methods of keeping accounts of materials used, labor, tools, etc., are very complete and make it possible to classify expenditures in almost any manner desired. As examples of the methods used two or three of the report cards are reproduced.

The first given is the team card, which gives full information of the amounts of material sent out, the time required to make the delivery, the location of the work to which delivery is made. Everything on these team cards, which are made out in duplicate at the plant, must be accounted for on the reports of the foremen in charge of the work to which deliveries are made.

The second and third cuts show the two sides of the daily asphalt plant report. On one side is the detailed account of the labor and teams used, including the overhead charge, and on the other side is the detailed account of the materials used in making mixtures sent out, with time losses and unit and total costs. These are made up from the foreman's and superin-

tendent's reports and prices paid for materials by a clerk whose duty it is to keep exact account of everything which comes into and goes out of the plant, whether materials, tools or labor.

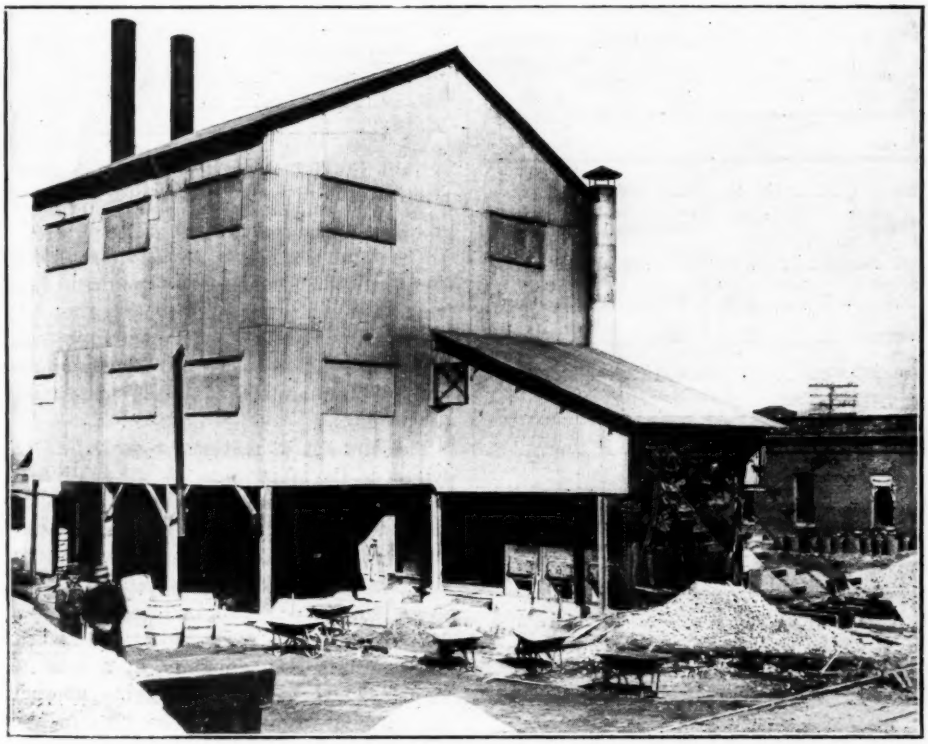
Each foreman in charge of a job makes out a corresponding daily card for the work under his charge. One side, which is practically the same as that on the plant card, gives the detail of labor employed and the other, shown in the fourth cut, shows the materials received and used. The two sets of column show the materials used in maintenance work and in private work respectively. The latter set is used for flush-coat work also. Prices are inserted and computed in the office.

The A. C. mixture used is designated by number and the cost is computed per ton, from the known cost of each ingredient. The total charge in kettle No. 1 is 14,055 pounds.

Top mixture A contains 115 pounds of A. C., 120 pounds of limestone dust and 800 pounds of sand, 200 pounds coarse and 600 pounds fine, per box. Top mixture B contains 115 pounds of A. C., 150 pounds of limestone dust and 800 pounds of sand of the same proportions of coarse and fine.

Each item in stock has a stock card with spaces for entering receipts and withdrawals and keeping exact tally of balance on hand so that an inventory can be made up at any time and it can be checked by measurements or counts of material in the stockroom, bins or tanks.

The overhead charges are computed at about $21.00 a day and include five men, the engineer in charge and clerk, the superintendent, chemist and helper. This charge is divided each day equally between the gangs at work, the asphalt plant counting as one gang, and any road-oiling gang being counted also. The division oils macadam streets and has



MUNICIPAL ASPHALT *plant of St. Louis, Mo., built by Warren Bros. Co. and operated by the St. Louis Street Department. This plant delivered and laid over* 105,000 *cubic feet of mixture at an average cost of* 61.2 *cents per square yard, during the year ending April,* 1913.

been doing some successful work in oiling and sanding and in flush-coating wooden block, brick, asphalt and bitulithic streets.

The figures from these reports are worked out in detail and summaries are made. From the summary by months the following figures are taken for the year ending April, 1913:

The plant delivered 105,287 cubic feet of asphalt mixtures during the year.

Labor cost for actual working time.	$14,212.50
Idle time paid for	3,899.15
Material	17,588.27
Fuel	1,547.83
Labor of repairs	780.21
Total cost at the plant	$38,026.96

Municipal Asphalt Repair Plant
SAINT LOUIS

Kingshighway and Eager Road

191

Location _____

Team: _____

Top / Binder	____ Cu. Ft.	Coal Oil	____ Gals.
		Naphtha	____ Gals
____ Sand	____ Cu. Ft.	Coal	____ Lbs.
____ A. C.	____ Lbs.	Wood	____ Cords
Cement	____ Lbs	Coke	____ Bu.

Flush Coat ____ Gals. Temp. ____ of

Mix: _____

Road Oil ____ Gals. Temp. ____ of Kind ____

Tools _____

2909

LEAVING ARRIVING

Time: _____

FOREMAN

Remarks _____

MANUFACTURED BY AMERICAN SALES BOOK CO. LIMITED, NIAGARA FALLS, N. Y.

A RECORD *of every load of material which leaves the plant is kept on this card. A separate card is used for each load.*

ST. LOUIS STREET DEPARTMENT
BITUMINOUS ROADWAYS
DAILY ASPHALT PLANT REPORT

Weather _____ Day _____

Cu. Ft. Mix. { Top _____ Total Cost per Cu. Ft. Del'v'd _____ / Binder _____ } 19

Material	Used	Price per	Mix. etc.	Total Cost	
Asphaltic Cement	Lbs.	Ton			
Asphaltic Cement	"	"			
F. Sand	Cu. ft.	Cu. yd.			
C. Sand	"	"			
Dust	Lbs.	Ton			
Cement	"	100 Lbs.			
Flux Oil	Gals.	Gals.			
Cup Grease	Lbs.	Lbs.			
Graphite	"	"			
Cyl. Oil	Gals.	Gals.			
Eng. Oil	"	"			
Coal Oil	"	"			
Naphtha	"	"			
Road Oil h'vy	"	"			
Road Oil lt.	"	"			
A. C. Paint	"	"			
Idle Time					
Cause					
Plant Repairs On					
Material & Fuel Cost					
Labor Cost					
Foreman					

THE DAILY *plant report, which gives the amount of each kind of material used and the cost.*

The total plant cost per cubic foot was therefore 36.12 cents. Not counting idle time paid for and labor of repairs, the plant cost was 31.67 cents per cubic foot. The latter varied between 27.29 cents minimum (January) and 36.64 maximum (February).

The amount of material reported as received on the street was 100,255 cubic feet, a loss of 5,032 cubic feet or 5 per cent., largely due to material turned out during the season for use during the winter by heating in pans. This amount laid 89,608 square yards of maintenance work and 4,059 square yards of private work, such as cuts in pavements, or a total of 93,767 square yards, making the average thickness of asphalt laid about 1.4 inches.

On the street the cost was for actual production labor	$16,673.06
For lost time	1,970.81
Total labor cost on street	$18,643.87

The plant cost of the material from above is.....$38,026.96
Fuel on the street cost..... 708.16

The total cost laid on the street is $57,378.99

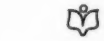
The total cost of material actually delivered and laid on the street is 57.2 cents per cubic foot and 61.2 cents per square yard. The monthly average cost per square yard laid in the street, not including idle time and repairs, varied from a minimum of 28 cents in November to a maximum of 85 cents in March.

The private work in filling cuts in streets is done on notification from the department having charge of such excavations, the notice giving the name of the plumber, gas company or other party making the cut, as derived from the permit, the exact location of the cut, the area of cut and the amount of pavement adjoining the cut to be repaired. A duplicate of the permit is made on a sheet giving room for report of inspector which carries the plumber's and the inspector's signatures and dates of inspection, size of opening, etc.

Amount charged for repair of cuts is $2.00 a square yard for top alone and $3.00 for both concrete and top. Minimum charge on gas company's cuts is $5.00 and on some other contracts is $10.00. An amount is deposited equal to the estimated cost of the repair. The department making repair, in this case the bituminous roadways division, reports to the excavation division the cost of the repairs as computed on the blanks shown, so that the accounts are kept up to date.

The plant chemist makes determinations from each batch of penetration and bitumen, and at sufficient intervals to keep control, of percentages of bitumen and of mineral matter retained on No. 10, 40, 80, 200 and passing No. 200 sieves. The municipal testing laboratory tests and analyzes all materials offered for purchase and the plant chemist checks the quality of those delivered and controls the mixtures.

The city of St. Louis is establishing a uniform system of accounts on the basis of a preliminary survey of certain city departments, published in 1910, under authority of an ordinance passed in April, 1911. Peter White was employed in September, 1911, to make the revision. A careful analysis of all vouchers of the fiscal year ending April, 1912, was made, and all departments have been working toward a uniform system. It has been impossible, however, to work out all the details of this system in one year. An



LABOR REPORT, *upon which is recorded daily expenses incident to plant operation. On the reverse of this card appears the "Plant Report" shown on opposite page.*

Occupation	NAME	hrs.	Total		Occupation	NAME	hrs.	Total	
Overhead					Laborers				
Foreman					"				
Engineer					"				
"					"				
Clerk					Teams				
Timekeeper									
Stockman									
Blacksmith									
Chauffeur									
Fireman									
Mixerman									
Kettleman									
Laborers									
"									
"									
"									
"									

indication of the work done and to be done and of the forms of accounts and reports which have been definitely detailed is given in a special report of the bureau of revision and accounts and methods dated April 13, 1913. Meantime there are some duplications and overlapping of authorities which make difficulties, and some useless expenditures.

system of accounting is made wholly satisfactory.

This may be possible, tho it will be very difficult, and it can only be done by co-operation of the various officials with the bureau of revision of accounts, and particularly thru the recognition by that department of the importance of some rather minute details and of the necessity of expert knowledge of them.

No system of co-ordination and co-operation of departments and divisions of departments has yet been devised in either private or public corporation management which will work without the co-operation of the individuals in those departments for the good of the service and not for the advancement of their individual interests.

A good beginning has been made in St. Louis and the work should be continued until all the details have been worked out, tho that may take several years.

W 19	MAINTENANCE			PRIVATE WORK-FLUSH COAT		
City of St. Louis Street Dept. Bituminous Roadways Asphalt Surface Laid	Street From To Yds. Cost per yd.			Street From To Yds. Cost per yd.		
NAME OF MATERIALS	Am't Used	Price per	Total Cost	Am't Used	Price per	Total Cost
Tor Mixture	Cu. ft.	Cu. ft.				
Binder Mixture	"	"				
Asphaltic Cement	Lbs.	100 Lbs.				
Paint Mix.	"	"				
Wood	C'ds.	C'ds.				
Coal	Lbs.	100 Lbs.				
Cement	"	Lbs.				
Coal Oil	Gals.	Gals.				
Naphtha	"	"				
Sand (Meramec / Coarse River)	Cu. ft.	Cu. yd.				
Flux ( )	Gal.	Gals.				
Labor Cost						
Material & Fuel Cost						

STREET FOREMAN'S *report on maintenance, flush-coat and private work. The labor report on the reverse of this card is similar to that on page* 327.

With respect to the bituminous roadways department, there are relations with the street construction department, the street maintenance department, and the excavation division, which must be worked out and put into their proper subordination or independence before the

LOCATING LEAKS IN WATER MAINS

***

Two successful but totally different methods.

IN two papers before the New England Water Works Association are given methods of determining the location of leaks in water mains which should be material aids in this difficult process. The first paper is by F. J. Hoxie, of Boston, Mass., on "Method of Locating Leaks in Water Mains," and the second method of locating large leaks is taken from a paper by William W. Brush, deputy chief engineer of the Bureau of Water Supply, Department of Water Supply, Gas and Electricity of New York City, on "Water Waste Prevention Work in New York City."

Mr. Hoxie's contribution is abstracted as follows:

The possibilities of aquaphones and other acoustic devices having been exhausted in an attempt to locate leaks in the underground pipes of a factory fire service system, a method using an alkaline solution injected into the pipe was developed and located the leak within six feet. Similar success is reported in other cases.

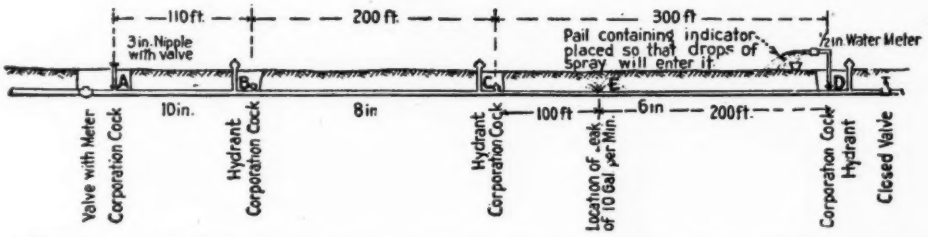
Caustic soda was selected because it gives a very sharp indication, is not particularly poisonous, and in the dilute solutions required has no objectionable color, taste, or smell and does no damage to pipes, gates, or fittings. Carbonate of soda, that is, washing soda, or soda ash, will work equally well. The method can be used on public systems by taking the precaution to shut off domestic connection while the measurements are being made, and flushing the pipes afterward.

After locating the leak within reasonable limits by use of section valves and meters, its magnitude should be determined by placing a small meter around a closed valve.

The case assumed by Mr. Hoxie is shown in the sketch and by closing the valve near D, and all connections from A to D and putting a meter on the valve near A, a leakage of 10 gallons a minute was observed.

Alkali is introduced into the piping as near as possible to the source of supply—at the point A in the sketch.

A ½-in. or ¾-in. hole is tapped in the pipe by use of a pipe tapping machine such as commonly used by the public water works. To the corporation cock at A, which is left in the pipe after it is



METER *on valve at extreme left. Closed valve on extreme right. Alkali admitted at A, B, C and D are points of making tests. Contents of ten-inch pipe A-B are* 110x4.08, *or* 449 *gallons. Contents of eight-inch pipe B-C are* 200x2.62, *or* 524 *gallons. Contents of six-inch pipe C-D are* 300x1.47, *or* 441 *gallons. Observed amount of leakage being ten gallons, time of flow thru lengths named is one-tenth their respective contents. Distance from D to E, location of leak, is observed discharge thru meter opened at D divided by* 1.47, *or* 200 *feet.*

tapped, a 3-in. nipple about 18 in. long is attached with a reducing coupling and nipple at the lower end and a 3-in. valve at the upper end to prevent the water from flowing out. When in place the corporation cock is opened a small amount and the 3-in. nipple allowed to fill with water. Then two or three pounds of solid caustic soda or potash is placed in this 3-in. nipple, the valve is closed, and the corporation cock is opened so that the caustic solution can diffuse into the pipe. The time that the corporation cock is opened is noted.

If the leak is beyond B the alkali will be carried to B as rapidly as the 10-gallon leak can change the water in the pipe A—B, or 449 gallons divided by 10 gallons, making 44.9 minutes. A few spoonsful of water drawn from the cock at B into a pail containing a half teaspoonful of phenolphthalein indicator will then show the arrival of the alkali. If it requires more time than 45 minutes, part of the leak is between A and B and part beyond.

Similar tests should be made at C 52.4 minutes after the first arrival of the alkali at B, to ascertain whether the pipe B—C is tight; likewise at D.

When the alkali fails to appear in 10 or 15 minutes after it is due, a meter should be attached and read and the water drawn off until the alkali test responds, when the flow is stopped. In the assumed case, observed flow being 294 gallons, the distance thru which the alkali was drawn by the water drawn off is 294 divided by 1.47, the capacity of the pipe per foot, or 200 feet, and the leak is 200 feet back from D.

If the pipe is level or slopes down toward D the point will be indicated nearer D than the actual distance as the caustic solution is heavier than water and tends to flow downward under the water. The same unreliability obtains of the slope is downward from the point of entry of the alkali to the leak, but if the slope is upward the accuracy will be within the limits of the conditions of the experiment.

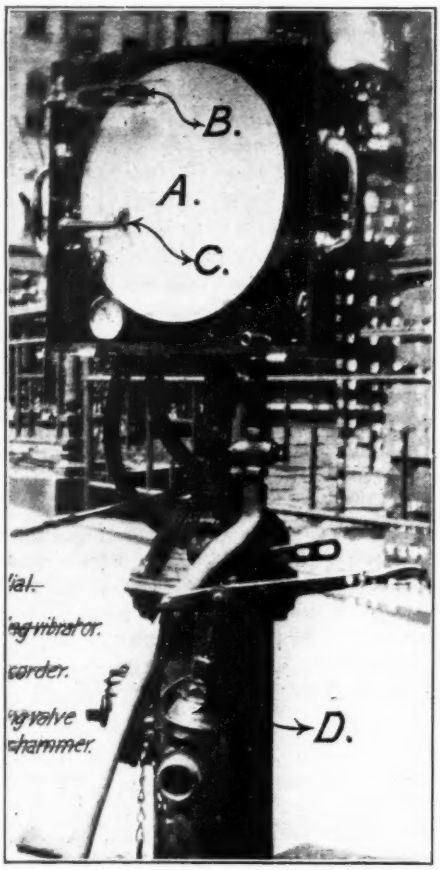
In case several leaks are indicated, the second test will locate the next leak along the line from D toward A, and so on until all are found and stopped.

The alkali should all be flushed out of the pipe thru the hydrants before the valve near D and the house connections are opened and the use of the water resumed.

This method will not be found of much service for single leaks of less than one or two gallons per minute.

Hydrants and calibrated nozzles can be used instead of corporation cocks and meter for preliminary or approximate determinations. The results are not as accurate, however, and leaky hydrant drips may give trouble.

The phenolphthalein solution is formed by dissolving the dry powder, which may be purchased at any chem-

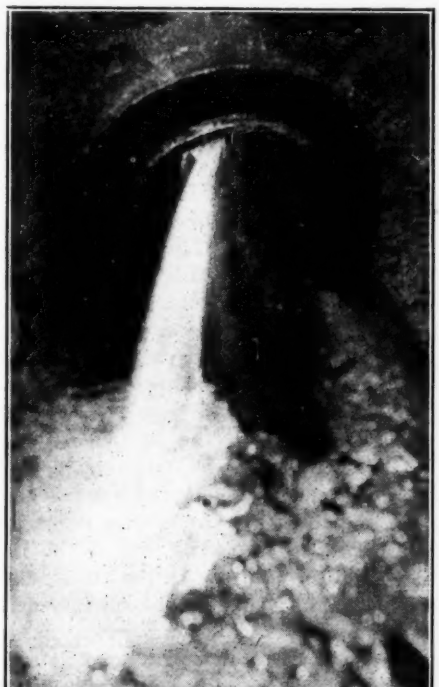


LOCATING LEAK *in water main by Pulsograph, shown in place on hydrant. A—Recording dial. B—Time recording vibrator. C—Pressure recorder. D—Quick operating valve to create hammer.*

ical supply store, in the proportion of ⅛ ounce in a pint of wood alcohol.

Mr. Brush located leaks in distribution mains by the use of a "pulsograph," invented by Mr. A. Akimoff, of Philadelphia, which is shown in the accompanying photograph. This instrument is based upon the water hammer experiments made in Russia in 1897-98 and reported in paper by N. Jonkowsky before the Russian Technical Society, April 9, 1898. It consists essentially of a large sensitive pressure recorder having a rapid motion, a tuning fork vibrating at a rate of 200 per second, and a quick-operating valve which is on a blow-off or by-pass pipe.

The instrument is set up by screwing it to a hydrant nozzle, the hydrant being chosen so that there will be a straight run of several hundred feet before an open four-way branch is encountered. By closing valves on intermediate branches, the effect of a long isolated line can be obtained. In operation, the valve on the main below the hydrant is closed, and water allowed to flow from the hydrant thru the by-pass on the instrument. By quickly closing the by-pass valve, a water hammer of about fifteen pounds is created and recorded on the pressure gage. This pressure is maintained until the water-hammer pressure has reached the open branch at the end of the pipe line that is being tested and the drop in pressure has traveled back to the hydrant, the tuning fork vibrations showing the time for this double travel. By dividing twice the distance along the main to the open branch by the time, the rate of travel for the particular pipe is determined. This has been found to be approximately 3,600 ft. per second for 6-in. pipe and increasing to about 4,200 ft. for 12-in. pipe. If there is any leak in the main, or in a service near the main, the water-hammer pressure is materially reduced by said leak and the chart shows separately the reduction due both to the leak and the open branch. The distance to the leak can then be determined by the time shown on the chart for the water-hammer pressure to travel to the leak and return to the pulsograph, this being multiplied by the determined rate of travel of the hammer pressure along the pipe, and divided by two. Several leaks have been located within limits of less than twenty feet by the use of this instrument, and the results from its further use should be interesting, as a decided saving in cost of locating leaks is anticipated.



PARTIALLY *blown joint leaking* 29,000 *gallons a day. Leak located by Pulsograph.*

MUNICIPAL SLAUGHTER HOUSE
at
Grand Forks, N. Dak.

Many of the Smaller Cities are Confronted with the Problem of Sanitary Slaughtering. This City will Operate Its Own Plant.

By H. G. Lykken, City Engineer.

GRAND FORKS, North Dakota, is a city of about 14,000 population, situated in an agricultural district, but where little attention has been given to the cattle industry. Only a small portion of the meat supply is available locally, yet the problem of a sanitary slaughtering house has been a serious one for a considerable time. One offensive and filthy shed where such work has been done was closed after the other. No private interest could be persuaded to enter the field and provide a sanitary place, however.

So the city took the matter up about a year ago, got a bill thru the legislature authorizing the cities in North Dakota to erect slaughter houses, and set about to gather information on the subject. The writer and the chairman of the ways and means committee of the city council visited Duluth, Minn.; Superior, Wis.; St. Cloud, Fergus Falls, and Moorhead, Minn., and Fargo, N. D. Information was gotten from the municipal plant at Paris, Texas, and other places.

It may not be so much of interest to know what the committee saw at these places. It would take too much space to record details, many of which would have little bearing on the object in view. Much was learned at each place and my endeavor shall be to summarize the conclusions arrived at. The city adopted the recommendation of the committee and has called an election for the issuance of bonds in the sum of $12,000 to erect the plant suggested and the writer is preparing plans for the same.

This plant will be constructed of brick, with concrete floors and tar and gravel roof. It will have a hog-killing room 15 by 30 feet, a beef-killing room 35 by 30 feet provided with three beds and hoists. There will be a cooler having an alley or entrance room 9 by 20 feet, and a cooling room proper 20 by 30 feet. This cooler is provided with a nice loft and sufficient ice is to be put in during the winter to run thru the summer season. Under the killing rooms is a basement 30 by 50 feet, cut up into various work and storage rooms. Adjacent to the killing room is a rendering room 10 by 15 feet. The top of the rendering tank is level with the killing floors so that all material can be conveniently dumped in. An outside door into the rendering room is provided for the admission of dead animals and material shipped in to be rendered. The tank proper is in the basement of the rendering room with an exit for the removal of tankage, and a door into the basement proper for the storage of the tallow.

This plant will be equipped with a system of trolleys thruout, a forty-horse power boiler, rendering tank and dryer, and, of course, all water and sewer facilities. Floors and walls up to a height of six feet will be finished with a hard portland cement plaster. The basement will

afford room for rendering lard and working up various other by-products, salting hides, etc.

The city will put a competent man in charge of the plant who will keep it clean, do the rendering and keep it in shape generally. He will also do such inspection of the carcasses as may be necessary to prevent the use of diseased animals. The intention is to let the butchers do their own work at the plant, as the local men claim they have to keep a certain amount of help anyway. A charge of 60 cents will be made for beeves, 30 cents for hogs and 25 cents for sheep and calves. This will include storage in the cooler for a few days.

It may be that the city will lease the plant for a term of years based upon its maintenance in accordance with the city ordinances, the proper inspection of slaughtered animals and a maximum schedule of charges.

In either case all meat not slaughtered under government inspection will have to be slaughtered in this plant. In case it is desired, the man in charge of the plant, or his help, if he needs some, will do the slaughtering for so much per head, additional.

¶ INSPECTION *of private plants influenced the layout and general design of this one.*

Referring back to the results of the inspection trip made and information gathered from other sources as the reason for the various recommendations made for the local plant, the following may be of interest. A hog-killing room was installed separate from the main beef-killing room for the reason that the use of hot water for scalding and the accompanying steam and odors are best kept out of the latter, and for the further reason that the work could be done at the same time in both departments with less disturbance of each other. Three killing beds were put in for the beef-killing as it was found advantageous to enable three sets of butchers to work at the same time.

The ice cooler was determined upon on account of the smaller initial cost as well as the smaller cost of operation. In a slaughter house such as the one planned, it is desirable to keep the meat for a day or more in some sort of storage. It would be of advantage to the butcher to have to kill only once or at most twice a week. Besides, it is generally recognized that the meat is benefited by a few days' refrigeration. As a temperature from 36 to 40 degrees Fahrenheit is sufficient for this purpose, a well constructed ice cooler will serve the purpose very well. If correctly designed, two hundred tons of ice will be put into the loft in winter, which will run the plant for the season, necessitating no attention whatsoever. There appears to be no call for a freezing temperature unless it is desired to go into a cold storage proposition. The freshly dressed animal is rolled into the alley or entrance to the cooler and left for twenty-four hours in order to rid it of the animal heat and considerable moisture given off at this stage of the cooling. This alley is well ventilated and the arrangement is absolutely necessary to obviate a damp cooler.

The rendering tank adopted is arranged for drying the tankage. After the tallow has been run off the remaining material is dried and sold as fertilizer. Both the tallow and fertilizer have good market value and will go a long way toward paying the operating expenses of the plant. There need be no perceptible odor about such a plant, as the materials to be tanked may best be put in while fresh. The tank is hermetically sealed and is not opened until the dry and powdery tankage is taken out. There is, of course, odor from the exhaust pump used when the tankage is dried, but this can be brought into the furnace under the boiler and destroyed. Every thing about the plant can be kept scrupulously clean, and all windows and doors should be screened. Condemned carcasses as well as other dead animals can be tanked out and provisions should be made to bring same into the tankage room from a separate unloading platform provided for that purpose.

Bond issue carried August 12, 1913.

Corrosion of Pipes by Raw and Treated Waters

By FRANK E. HALE, Mount Prospect Laboratory, Department of Water Supply, Gas and Electricity, Brooklyn, N. Y.

THE question of corrosion of iron pipes by water supply was given an extended investigation of six months at Mt. Pleasant laboratory during the first half of 1912. These experiments are the basis for the following discussion.

In order to understand the problem it is necessary to have a clear conception of the chemical reactions taking place. While the electric theory of solution tension of iron may be correct as the ultimate source of corrosion, it is my belief that the cart has been put before the horse and that the electrical phenomena result from the chemical action. Certain it is that the presence of carbonic acid is the most potent factor, coupled with the presence of dissolved oxygen. The action of these two agents is modified by the presence of other salts, increased by nitrates which furnish oxygen by reduction, decreased by carbonates which help to form protective coatings upon the pipe.

The chemical action takes place in the following order:

The first reaction is the solution of iron as bicarbonate by carbonic acid with the formation of hydrogen.

$$Fe+2H_2CO_3=FeH_2(CO_3)_2+H_2.$$

The dissolved oxygen in the water which is near the iron surface oxidizes some of the hydrogen back to water. After the oxygen near the iron is used up the hydrogen remains as a gas. In the cold reaction of our experiments the amount of hydrogen oxidized was found to be about 20 per cent.

The dissolved oxygen at the same time oxidizes the soluble iron bicarbonate to insoluble red iron setting free again the carbonic acid.

$$4FeH_2(CO_3)_2+O_2+4H_2O=2Fe_2+8H_2CO_3.$$
$$4FeH_4(CO_3)_4+O_2+4H_2O=2Fe_2+8H_2CO_3.$$
$$2Fe_2O_3+8H_2CO_3.$$

The carbonic acid, set free, again dissolves more iron and is again set free until all of the dissolved oxygen is exhausted.

The red iron oxide then acts as oxidizer until it is completely reduced to black magnetic iron oxide, setting free carbonic acid again.

$$FeH_2(CO_3)_2+Fe_2O_3+H_2O=Fe_3O_4+2H_2CO_3.$$

Reduction does not take place beyond this stage. These iron products are expressed in the equations as oxides altho differences of color, red, green, brown and black, coupled with varying stability on standing exposed to air indicate that they probably exist as hydrates, with the exception of the final black magnetic oxide obtained by hot action.

After all dissovled oxygen has been used up nitrates are completely reduced to ammonia, serving to supply oxygen.

$$HNO_3+H_2O=NH_3+O_2.$$

After all possible sources of oxygen are exhausted, the carbonic acid dissolves more iron, which is probably thrown out of solution finally as insoluble basic carbonate of iron, since after complete reaction there is only about 0.2 to 0.7 p.p.m. iron in solution, no free carbonic acid, no dissolved oxygen, no nitrate, sometimes no bicarbonic acid, and under some conditions caustic lime is present. The alkalinity of hard waters is reduced to about 25 p.p.m.

The carbonic acid for the solvent action may be derived from three sources, the free carbonic acid, the bicarbonic acid, and the neutral carbonate. In the

Paper read before the American Public Health Association.

latter case the carbonate hydrolyzes so that there are in solution neutral carbonate, lime hydrate, and carbonic acid. This takes place when the water reaches the stage that only neutral carbonate is present. The carbonic acid set free dissolves the iron. The presence of lime hydrate was proven by titration with phenolphtalein and methyl orange.

The rapidity of corrosive action is affected by the source of carbonic acid in order as given above, and the amount of soluble iron present during the active stages of corrosion varies with the above order of source of carbonic acid.

Another source of carbonic acid is that set free in alum-treated waters. This is really mostly bicarbonic acid set free. The amount set free per grain of alum per gallon is not as sometimes stated 6.8 p.p.m., but about 3.5 p.p.m. (determined by analysis). This is probably due to the formation of a basic carbonate of aluminum, $AlCO_3(OH)$, rather than the hydrate, $Al(OH)_3$. The compound formed probably varies somewhat with the temperature and may be mixtures of $AlCO_3(OH)$ and $Al_2(CO_3)(OH)_4$. Probably $Al(OH)_3$ forms only upon boiling, as in chemical analysis. The amount of free carbonic acid given, 3.5 p.p.m., agrees with the results obtained at the Little Falls filter plant.

It must be understood that the facts as given above apply to new pipe with a clean iron surface and to complete reaction.

Attempts to remove dissolved oxygen from water appear to me to be hopeless as well as expensive, because a consideration of the above reaction brings out a fact that seems to me to have escaped general attention, and that is that 15 per cent. of the oxygen in the iron oxides formed by complete reaction, if all the hydrogen were set free, comes from the water and not from the dissolved oxygen, and the greater part of the hydrogen is set free.

A very large amount of iron is corroded for each part per million of dissolved oxygen, thru the catalytic action of carbonic acid and water. For example, 10 p.p.m. of dissolved oxygen produces 126 p.p.m. Fe_2O_4, expressed as Fe, whereas if the hydrogen were oxidized and not set free, the amount which 10 p.p.m. oxygen could produce would be only 31 p.p.m. iron. In our experiments 75 to 80 per cent. of this theoretical amount of iron was produced, the difference from theory being due to oxidation of hydrogen. This is a variable quantity, but about 85 per cent. of the hydrogen oxidized was oxidized during the first fifteen minutes, which substantiates the idea expressed previously that oxidation of hydrogen takes place only at the surface of the iron while dissolved oxygen is present near the iron. The presence of hydrogen gas is easily shown and has been proven by many investigators. Any hydrogen set free means an equivalent amount of oxygen obtained from the water to oxidize the iron.

¶ EXPERIMENTS *conducted with three kinds of pipe.*

The experiments were carried out with Byers wrought iron pipe (protected with an inside coat), Reading wrought iron, Black mild steel, and galvanized wrought iron. The first three showed no differences in the corrosive action when carried to completion, but the steel appeared to corrode most rapidly. The galvanized iron showed great resistance at first, but gradually, especially with alkaline water, the action increased somewhat, tho in the time of our experiments the highest amount was only about one-third that of the other pipes.

Experiments with regard to speed of reaction brought out some surprising facts.

About 50 per cent. of the iron produced by corrosion in the cold is produced in two to three hours. With Croton water (5 p.p.m. free carbonic acid) the action is practically complete in fifteen hours. This explains the greater tendency in house services, especially in new services, to show rusty water when first drawn in the morning, since the action is complete over night.

The rate of corrosion is increased proportionately to the increase in free carbonic acid. The action cold was complete

in seven to eight hours with Croton water containing 25 to 50 p.p.m. free carbonic acid. The total iron was also somewhat increased with the higher free carbonic acid. The carbonic acid hastens the action by dissolving the iron more rapidly. There being more iron in solution, oxidation is hastened. Analyses for soluble iron and dissolved oxygen proved this to be true. The carbonic acid increases the total iron by forming basic carbonate of iron which is left unoxidized after available oxygen is exhausted.

Alum-treated water showed no appreciably greater corrosive action either in speed or total amount of iron than untreated water. This is due to the comparatively slight increase in free carbonic acid (3.5 p.p.m. per grain of alum per gallon).

Neutralization of the free carbonic acid retards the corrosive action. Neutralization of the free carbonic acid by lime hydrate or by sodium carbonate retards the corrosive action. Neutralization of the free and half-bound carbonic acid by lime hydrate, provided there is no excess caustic, still further retards the corrosive action, and also reduces the total iron produced by cold action 33 per cent. and by hot action 50 per cent. Neutralization of carbonic acid retards corrosion by reducing the amount of dissolving agent, hence the amount of soluble iron present at any moment, and thus slows up the oxidation.

The slightest excess caustic (a few p.p.m.) up to considerable excess hastens corrosion to almost identically the same degree as does increasing the free carbonic acid to 25 to 50 p.p.m. A large excess of soda-ash acts likewise. This action of alkalies has been noted by Cushman and others.

Excess alkali hastens the corrosion by hastening the absorption of oxygen by the iron in solution, tho this is smaller in amount at any time. Until the excess of alkali is sufficient to prevent hydrolysis of carbonates the corrosion takes place. Analyses proved that the oxygen is absorbed faster and that only traces of iron are in solution at any time. Compare in this connection the Levy method of determining dissolved oxygen in water, i. e., oxidation of ferrous salts in alkaline condition.

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¶ RED WATER *trouble caused by an excess of iron dissolved or suspended.*

The excess of alkali necessary to stop corrosion completely is 100 to 125 p.p.m. excess lime hydrate over that needed to neutralize the free and half-bound carbonic acid. Only slightly more is needed to stop corrosion hot than cold. This amount of excess alkali acts by completely preventing solution of iron, for the oxygen still oxidizes the surface of the iron and is completely gone in twenty-four hours, altho no iron over the original amount appears in the water.

The above facts show that whatever helps to put iron into solution is the real cause of red water trouble. It is the iron in the water, dissolved or suspended, which causes trouble, not the iron clinging to the pipe.

All corrosive action was hastened by heat (120-150 degrees F.) so that complete reaction was accomplished in one and a half to three hours on the clean iron surface. Heat hastens corrosion in at least four ways—by hastening the chemical action of solution of iron, by increasing the amount of free carbonic acid since heat sets free the half-bound carbonic acid of the alkalinity, by creating convection currents that cause the dissolved iron to diffuse more rapidly and hence come in contact with the dissolved oxygen faster, and by hastening the oxidation and precipitation chemically of the dissolved iron.

The water of the Flatbush Water Company, which has a hardness of about 140 p.p.m., contains only two-thirds as much oxygen as Croton water and 10 p.p.m. free carbonic acid, produced corrosion as rapidly as Croton water on the clean iron surface and a total amount proportional to the oxygen and carbonic acid content as required by theory. Yet in service this water causes no complaint and is generally free from iron and turbidity. This is undoubtedly due to protective

scale formed on the pipe, probably consisting of both iron oxide and carbonate of lime. As previously stated the alkalinity of hard waters is reduced to about 25 p.p.m. when the action goes to completion.

Dissolved oxygen disappears rapidly in all cases. In the first fifteen minutes 23 to 37 per cent. were used up due to oxidation of both hydrogen and dissolved iron.

The relative speed of oxidation is best seen in comparing percentages of oxygen used up to one and a half hours.

Temp.	Croton Water	Free CO_2	Bicarbonic acid	Lime hydrate excess	Oxygen used up
1	Hot untreated	5 p.p.m	10 p.p.m.	.....	100 per cent.
2	Cold, modified	0 p.p.m.	0 p.p.m.	27 p.p.m.	87 per cent.
3	Cold, modified	25 p.p.m.	10 p.p.m.	.....	87 per cent.
4	Cold, untreated	5 p.p m.	10 p.p.m.	.....	78 per cent.
5	Cold, modified	0 p.p.m.	10 p.p.m.	.....	75 per cent.
6	Cold, modified	0 p.p.m.	0 p.p.m.	.....	68 per cent.

It is noticeable that the increases of dissolved oxygen used up in No. 3, No. 4 and No. 5 are approximately proportional to the increases in free carbonic acid in the water.

So long as there is oxygen in solution the reaction takes place rapidly and almost proportional to time and the iron precipitate is red (Fe_2O_3). After exhaustion of the oxygen the reaction becomes slower, the red oxide being reduced to the lower black oxide, turning green to brown to black. The color of the precipitate gives a good indication of the progress of the action.

While there is dissolved oxygen present there is iron in solution, depending upon the amount of active carbonic acid. Soon after the oxygen disappeared it was but rarely that more than 0.5 to 1.0 p.p.m. iron was in solution. The amount of soluble iron present while dissolved oxygen was present is shown below.

It is obvious that the amount of dissolved iron is greater with increase in the active carbonic acid.

The amount of oxygen within wide limits does not seem to affect the rate of

Croton water	Free CO_2	Bicarbonic acid	Lime hydrate excess	Soluble iron
Modified	0 p.p.m.	0 p.p.m.	27 p.p.m.	0.35 p.p.m.
Modified	0 p.p.m.	0 p.p.m.	.....	0.76 p.p.m.
Modified	0 p.p.m.	10 p.p.m.	.....	3.50 p.p.m.
Untreated	5 p.p.m.	10 p.p.m.	.....	5.50 p.p.m.
Modified	25 p.p.m.	10 p.p.m.	.....	7.90 p.p.m.

corrosion materially, but the total amount of iron removed from the pipes in complete reaction, other factors remaining the same, is directly proportional to the dissolved oxygen in the water.

When iron pipe is exposed to the continuous action of water, as in service, a protective coating forms according to the nature of the water. Its action is to delay corrosion rather than to stop it and to reduce the amount of iron appearing in the water. The corrosion goes on slowly but the oxides cling to the iron, increasing the amount of scale. In cold action the greatest protection was acquired experimentally in ten days and then remained constant. Flatbush and Brooklyn waters caused a better protective coating than Croton water. The iron produced in twenty-four hours dropped from 114 and 84 p.p.m. respectively for the two former to 21 p.p.m., Fe., for the Croton and its modifications from 56-102 to 29-35 p.p.m., Fe. Croton was tried in four modifications, untreated, with free carbonic acid neutralized by sodium carbonic acid neutralized by lime hydrate to bicarbonate, and treated with one grain per gallon of alum.

In hot action the protective coating formed in two days. Flatbush water reached the lowest level of 3 p.p.m. iron with an average of 8. Brooklyn water reached 4 p.p.m. iron with an average of 9. Untreated Croton fluctuated high and low with an average of 41 p.p.m. iron. The alum-treated Croton averaged 26. The soda-neutralized Croton averaged 23 p.p.m., Fe. All the averages, cold and hot, include results from the tenth to the twenty-first day.

The pipes which had acquired a protective coating from these different waters were subjected for twenty-four hours to the action of untreated Croton water and to Croton water containing 20-27 p.p.m. free carbonic acid. The water with increased carbonic acid produced an average of 38 p.p.m. iron from the pipes with scale formed in cold action, against 24 p.p.m. produced by untreated Croton (5 p.p.m. CO_2). On the pipes with scale produced in hot action about the same relative quantities were produced, 34 against 22 p.p.m., Fe., showing that water containing the greater amount of carbonic acid causes more corrosion upon pipes protected by scale.

The scale produced by Flatbush, Brooklyn, and soda-neutralized Croton water proved the more protective.

GENERAL SUMMARY.

Extensive corrosion takes place rapidly in new pipe while the iron is fairly clean from incrustation. This explains the abundance of complaints of iron rust in new service installation.

Concerning the kind of pipe there is little doubt that steel pipe is most readily attacked, wrought iron next, and galvanized iron the least. The latter is far preferable for use. Lead pipe should never be used any more than absolutely necessary because of the danger of accumulative poisoning with minute amounts of lead (less than 0.5 p.p.m.).

The chief agent in dissolving the iron is carbonic acid, as it is also the chief agent in holding iron in solution.

The chief agent in carrying the rusting to the greatest extent is oxygen.

Thru the catalytic action of active carbonic acid, about 70 per cent. of the oxygen in the iron rust comes from the water by chemical decomposition, hydrogen gas being set free. The remainder only, about 30 per cent., is furnished by the dissolved oxygen in the water.

¶ SOFT *water containing much free carbonic acid causes the most trouble.*

Waters which give the most trouble are very soft and contain considerable free carbonic acid.

Hard waters rarely cause complaint as they form an excellent protective coating on the pipes.

The action in distribution services probably never reaches completion on account of protecting scale of oxide, etc., which retards corrosive action. The scale varies with different waters in protective prop-

erties. Tap samples in New York City have shown no appreciable diminution in dissolved oxygen or in free carbonic acid, so that only slight corrosion can have taken place in proportion to volume of water and possible reaction. Even hot services have shown the usual amount of carbonic acid and more oxygen than would saturate the water at the temperature when drawn.

Since in distribution services there is no exhaustion of oxygen, any increase in free carbonic acid may mean a possible increase of soluble iron in the water, which would be precipitated in the hot water supply.

Neutralization of free and half-bound carbonic acid is impracticable as it tends to hasten corrosion if there be the slightest excess of hydrate, removes zinc when hot from galvanized pipe, interferes with alum precipitation and color removal, and produces considerable precipitation of calcium carbonate in the water, which would deposit in the pipe system, meters, etc., unless previously removed by filtration or sedimentation.

Neutralization of only free carbonic acid is feasible, since it retards corrosion and reduces the amount of soluble iron.

Either soda-ash or lime oxide may be used. Both reduce the corrosive action, cold or hot. Only sufficient lime should be used to form bicarbonate. This reagent increases the hardness 1.1 p.p.m. for every 1 p.p.m. free carbonic acid neutralized to bicarbonate. About 5.3 pounds CaO per million gallons of water are required for each 1 p.p.m. carbonic acid. It is best handled dry. It costs about two cents per million gallons per 1 p.p.m. carbonic acid.

Soda-ash is more soluble, can be handled in concentrated solution and consequently in small sized tanks, and probably with better regulation of dosage, would not increase the hardness, but on the contrary would decrease the lime sulphate in the water, changing it to sodium sulphate, thus improving the water for boiler use and for other industrial purposes. It also apparently helps to form a better protective coating on the pipe. About 20.2 pounds soda-ash per million gallons of water are required for each 1 p.p.m. carbonic acid. This would cost about 20 cents per million gallons for each 1 p.p.m. carbonic acid. Soda-ash has been used successfully on a small scale to obviate red water trouble. The great difference in cost is due to greater molecular weight, less combining power, and greater cost per pound. The cost must be considered in connection with the degree and advantage of the change of sulphates to carbonates, etc.

Aeration of water by splashing followed by neutralization of residual free carbonic acid (about 5 p.p.m.) is probably the best practice.

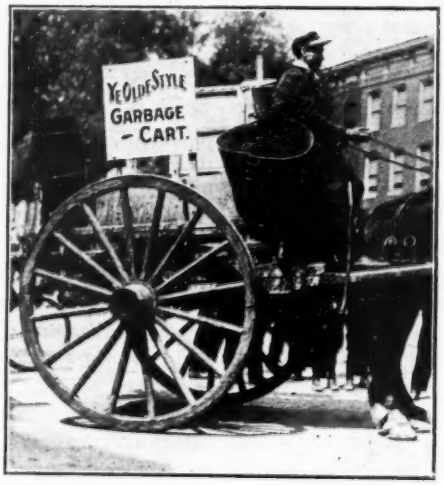
ROOTS *removed from sewers. Growths of this character indicate clearly the necessity of cleaning old sewers. Troubles like this can be largely eliminated by careful construction of joints.*

Street Cleaning Department of Baltimore, Md.

By STUART STEVENS SCOTT, Baltimore, Md.

WITH a department as well equipped as any in the country, Baltimore is winning fame as being one of the cleanest of American cities, despite the handicap of having the reputation of having less smooth streets and more cobble stones.

The reputation of being a clean city has not been earned without hard work on the part of the commissioner of street cleaning, William A. Larkins, who, first as district superintendent and now as chief, has put in fourteen years. During eleven years of this period Chief Larkins carried out many of his own ideas in his particular district, winning the commendation of his chief and having the satisfaction of seeing his ideas put into operation in other districts. For the past three years, as the commissioner, he has had full sway and he has used his knowledge and authority wisely, building up a department that is in many respects a model one.



UNSANITARY *and uneconomical old-style garbage cart.*

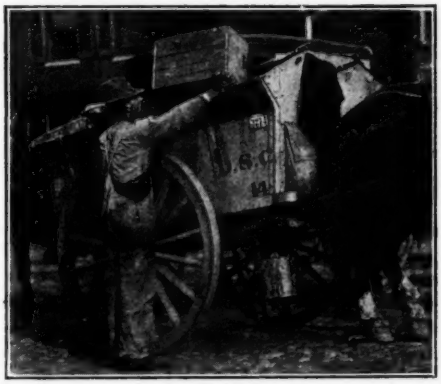
Altho municipal departments are naturally influenced by politics, the street cleaning department of the Monumental City is affected as little as any similar department anywhere. Chief Larkins and his staff look upon their men from one angle—efficiency—and that is the end of the argument. It is useless to argue. Unless the man is efficient he does not remain, no matter how good his political backing. If he is good in his work he is not only commended by his superiors, but annually, the best men are picked out and the mayor of the city pins upon his breast a little bronze medal on which is the word "Efficiency." And the men strive for this honor. Day after day, thruout the year the men labor on, each aware of being watched and each aware that only steady application to his work will warrant his being called some pretty May day when they will line up before the mayor, receive their honors and become envied by their less fortunate or less ambitious fellow workmen.

The street claining department of Baltimore is extensive. Its annual appropriation is over $800,000, yet every penny is so carefully expended that each year since he has been in office Chief Larkins has returned a balance to the city. Last year (1912) he returned $61,000.

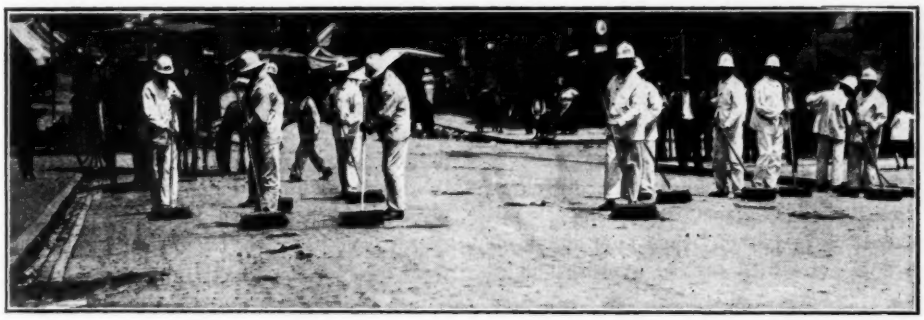
Chief Larkins' staff consists of a deputy commissioner, a chief clerk, a paymaster, two clerks and a stenographer in the office, four general superintendents, eight street superintendents, a superintendent of machines, an inspector and two assistants to look after garbage, two garbage dump inspectors, four foremen mounted on motor cycles, three foremen in the sanitary division and a chauffeur for the department automobile, used by the chief.

The corps of the department includes 310 sweepers, 150 street cart drivers, 30 sewer laborers, 12 drivers for sewer carts, 22 drivers for street sweeping machines, 205 garbage cart drivers, 10 drivers for squeegee machines, 2 scavengers for dead animals and 2 drivers for the garbage automobile. Directly in charge of this corps is a force of 24 foremen.

The stable equipment is extensive. There are four stables housing 310 horses, all property of the city. To take care of the animals there are at each stable a foreman and three hostlers. The department also has its own blacksmith shop, wheelwright shop, paint shop and sail-



TYPE *of garbage cart which has displaced those formerly used.*



BALTIMORE *White Wings, each man begins his day's work wearing a spotless uniform. No employe works over eight hours, but in some districts gangs are worked at night.*

loft, for each of the new sanitary wagons have canvas covers.

Including all hands there are on the payroll of the department 800 men and the annual payroll amounts to $525,000. Chief Larkins' salary is $3,000, and his deputy receives $2,000. Cart drivers and laborers receive $2 per day of eight hours; cart drivers who own and use their own horses receive $3 per day. Foremen receive $15 per week; superintendents of street cleaning $1,000 per year, and superintendents in the sanitary division, $1,200 per year.

SQUEEGEE *street cleaner, a number of which are in constant use.*

It costs, annually, about $66,500 to remove the garbage alone, but there is something in the way of remuneration to offset this, for the city has a contract, with a sliding scale, with the Southern Products Company, which not only takes all of the garbage, but which pays about $16,000 a year for it. This products company has a plant 10 miles from the city and all garbage is converted into grease which is used in the making of soap and axle grease.

The disposal of street sweepings and ashes is more serious, inasmuch as public dumping grounds are becoming scarce. Time was when there was a dump in each

section of the city. Now it is necessary to load the refuse on scows and carry it 10 or 15 miles down the bay. The long hauling of ashes made it necessary to adopt a more rapid means of transportation than horses, hence the purchase of a 7½-ton motor truck.

This truck has been in service about three months and it has proven so satisfactory that next year another truck will be bought. The truck goes to one section of the city one day and to another section another day and each trip it carries a load equal to what 26 street carts can carry. The time saved on each trip is equivalent to two and one-half hours per cart.

The scow service costs 23 cents per cubic yard of refuse and the records show that last year there were enough cubic yards disposed of to warrant a voucher for $25,000 being drawn in favor of the contractor.

Chief Larkins is more than ordinarily proud of his street men, his "white wings," for every day each man starts out in spotless white canvas overalls. There are all sorts of hours for the gangs. Some work all day, others all night, while there are gangs that start late and quit early, but no man works more than eight hours.

This assortment of hours, however, necessitates an almost eternal vigil on the part of the chief but, so far, he has proven equal to the situation and his big black automobile is just as likely to be seen purring around at 3:30 in the morning as at any other time. So too with the motorcycle corps. The quartet shift their working hours every week or two so that there is hardly a night but one of the four is riding around the city.

It is this vigilance on the part of the chief that has made the department what it is and have such an excellent record. Each year the chief calls all hands together and after the presentation of efficiency medals by the mayor the whole department parades thru the city. In this parade is not only practically every man in the department, but every piece of apparatus, each slicked down with bright paint, so that the people of Baltimore may see just where their tax money goes.

SEVEN *and one-half ton truck used by the Baltimore Street Cleaning Department.*

WATER SOFTENING AND DECOLORATION

at Grand Rapids, Mich.

By WALTER A. SPERRY,
Chief Chemist at Filter Plant, Grand Rapids, Mich.

THE first six months of experience at the Grand Rapids filtration plant has demonstrated that no plant can be successfully run by "rule of thumb." Every water supply, especially if it be a surface water supply, carries some features that make the treatment of that water distinctive and set apart.

The Grand Rapids plant started full normal operations about November 1, 1912, drawing water from the Grand river, it being originally proposed to soften this water down to about 125 parts per million total hardness, or what is generally known as the Lake Michigan standard, and to reduce its color to 10 or less on the platinum cobalt scale.

The Grand river drains an area of some two thousand square miles of sandy soil full of marshes and small lakes, with but little clay ground, being largely adapted to orchards and small fruits. Moreover the water is quite hard, due to limestone outcroppings. When one steeps tea leaves in water there results a color, an odor and a taste. The distinctive problem at the Grand Rapids plant has proved the removal of the effects of the steeping of the meadows in water that subsequently reached the Grand river. The problem was rendered more difficult in that in addition to its color the water was hard and hard waters seem more difficult to decolorize than soft waters, provided there is an absence of clay.

In this respect it is interesting to compare the water supply of Columbus, O., with that of Grand Rapids. The Grand Rapids supply, as noted above, is drawn from a sandy soil underlaid with limerock containing but little clay and with much vegetation and spotted all over with lakes and ponds. The Columbus supply is taken from the Scioto river, which flows thru a limestone region, wholly clay, and devoted to general farming operations with little or no swampy ground and but little sand. This result is a water at Columbus whose turbidity and total hardness rise and fall thru great ranges in very short periods of time, it being not unusual for the turbidity, for instance, to increase from 25 to 2,200 parts per million in a period of eight hours following heavy rains over the water shed, with a corresponding decrease in the hardness of the water. These phenomena are due to the clay nature of the soil, which lacks the "soaking up" and conserving capacity of lakes and sands and makes the Columbus problem largely one of coping with rapid changes of turbidity and hardness but with the color problem removed, in that the presence of much clay in this water tends to absorb and therefore eliminate its color.

¶ OBSTACLES *which it has been necessary to overcome.*

At Grand Rapids, on the other hand, the highest turbidity observed in the past six months has only been 135 with an average turbidity of 20 p.p.m. Moreover, due to the watershed being twice the area of the Scioto watershed, and due to the

much sand and many small lakes which tend to absorb and conserve storm water, the river does not rise and fall so rapidly nor does it get very turbid, and because of the absence of much suspended clay, turbidity, the color as well as a slight marshy taste and odor which accompany the color are much more persistent and difficult of removal. A secondary effect in rendering the color, odor and taste more difficult of removal is found in the opportunity for leaching out of the vegetable matter over the watershed offered by the conditions which tend to hold back the water. An interesting result of this condition is found in the summer time when, following a general rain, the color and taste become more pronounced, due to the washing into the stream of pools formed as a result of low water, where this leaching effect has become exaggerated.

¶ THE USE *of sulphate of alumina or iron absorbs and reduces color, odor and taste.*

Ordinarily sulphate of alumina or iron is used as a decoloring agent, their efficiencies depending on the fact that the reaction between the natural alkalinity of the water and the alumina or iron tends to break the latter up with the formation of alumina or iron hydrates, whose physical properties of weight, insolubility, and the possession of a bulky gelatinous mass, tend to make them absorb and reduce color and the accompanying odor and taste.

In the case of very soft and highly colored waters, such as are found in the East, it is necessary to supply a sufficient alkalinity to decompose the sulphates of alumina or iron in the form of lime hydrate and iron has in almost every case been found to work more efficiently when accompanied with sufficient lime to produce a slight excess of hydrate alkalinity, even tho there be already present in the water sufficient bicarbonate alkalinity. Moreover iron seems to exert more decolorizing and deodorizing power on some waters than alum, as is claimed for its use at a plant recently completed at Fargo, North Dakota, tho alum seems much more generally applicable. Where iron can be used it proves quite desirable, due to the lesser expense of iron as compared to alum.

The total hardness of the water at Grand Rapids has averaged 217 p.p.m with a maximum of 288 p.p.m. and a minimum of 104 p.p.m. This has been accompanied by an average color of 32 and an average turbidity of 20 p.p.m., the color ranging from 16 to 55 and the turbidity from 5 to 135 p.p.m. as minima and maxima. This total hardness was made up of the bicarbonates of calcium and magnesia averaging 188 p.p.m., accompanied by about 30 p.p.m. of sulphates and an average of 17 p.p.m. of magnesium for the past six months.

The first few days of operation showed that the amount of alum necessary to produce a water whose color was 10 or less was excessive, a water carrying a color of 30 to 40 p.p.m. requiring 3 to 4½ grains per gallon of alum to produce a water of the above requirements. Such treatment was not only expensive but so increased the sulphate or permanent hardness as to produce a very disagreeably hard water. Meantime laboratory experiments indicated that the use of lime would not only soften the water but decolorize it as well and at less expense.

¶ LIME *used to remove lime and an explanation of the chemical actions.*

It is oftentimes a puzzle as to why lime is used to remove lime. It is a basic chemical principle that an acid will combine with an alkali to produce a neutral body which is neither acid nor alkaline. Calcium and magnesium salts are largely present in a water by virtue of the solvent action of the carbonic acid gas dissolved in the water and are therefore present in an acid condition. By the addition of an equivalent amount of an alkaline form of lime, calcium hydrate, there is produced a neutral body which is insoluble, and if there should be five parts of such

acid calcium or magnesium present in a water the addition of five parts of calcium hydrate would precipitate out of the water 10 parts of lime which would contain the lime added as well as the lime present in the water. Moreover, magnesium so precipitated has much the same form physically as do the hydrates of alumina and iron and is available for the same uses, as coagulant to remove turbidity or color. It was proposed, therefore, to utilize the magnesium in the Grand river water supply thru the softening process as a decolorizing agent.

¶ USE *of sufficient lime has reduced the amount of alum, and consequently the unit cost of softening.*

Ordinarily the softening processes can be carried to any point desired up to the full neutralization of all acid lime present. At the Grand Rapids plant, however, it was soon found that unless sufficient lime were added to neutralize completely all bicarbonate or acid alkalinity, the magnesium was not precipitated in a form to be sufficiently available for decolorizing purposes and therefore we were compelled either to soften the water to a point much lower than the 120 or 125 p.p.m. desired or else operate at greater unit cost, in that a partial softening of the water made it necessary to use 2 to 3 grains of alum in addition to the lime to produce a satisfactory color. On the other hand by the addition of lime sufficient for the full neutralization of the bicarbonates present, it was found that we could produce a water whose color was 10 or less and whose total hardness ranged from 88 to 100 p.p.m. for the past six months. By so doing we were able to reduce the alum required to an amount as low as ¼ grain per gallon, its function being largely to help carry down the fine crystals of calcium carbonate formed in the softening process.

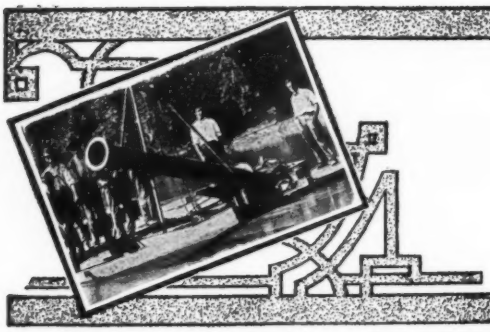
From the standpoint of the consumer, this was excellent, in that the water so produced was soft enough to lather freely in the cold and without the formation of the scums that are so disagreeably characteristic of hard water, as well as a water whose color was no longer noticeable. In addition this later method of treatment enables us to operate at a much less cost per million gallons than by the use of alum.

The use of alum, then, offered as an advantage color removal alone and as disadvantages increased cost of operation an increased hardness of the water produced. The use of lime offered as advantages the reduction of both hardness and color at greatly reduced cost as compared with alum, the disadvantages from the operator's standpoint being that once the people of any community become accustomed to a very soft water they also become sensitive to any upward changes of hardness and are therefore liable to notice and object to any increase in hardness later on.

¶ THE *methods in present use are the most economical and efficient for all seasons and kinds of water.*

So far as we have been able to study and observe our problem, this method of treatment with lime has proved most efficient and economical for all classes of waters the seasons have brought to our plant. Whether the color drops to as low as 20, as in the hard waters of the summer time, or rises to 60 or 70 following the spring floods, it requires excessive amounts of alum for its removal, and lime, therefore, proves most efficient, save for those short periods when the total hardness gets as low as 100 to 120 p.p.m. with the magnesium in the water falling off to 10 to 15 p.p.m., at which time alum must of necessity be used.

The average reduction of magnesium in the filtered water, following such treatment as the above, as compared to the river water, has been 25 per cent.



EDITORIAL

THE CURRENT CONVENTIONS

Some rather vexing questions have some new light thrown upon them by the papers at the September and October conventions of associations devoted to public service.

Two of these associations, the New England Water Works and the American Public Health, consider water and health problems. Special attention is called to the papers from Grand Rapids and Brooklyn at the latter association upon the economy of softening water and the corrosion of pipes by various raw and treated waters, as emphasizing points heretofore somewhat neglected, but of increasing importance.

The difficult problem of locating leaks in water mains has two solutions offered in papers before the former association from Boston and New York, which should give considerable aid. These and other important details of practice will be given to our readers in this and subsequent numbers.

Standardization of road and pavement specifications will be greatly promoted by the work done at the conventions of the National Paving Brick Manufacturers' Association in September, the American Highway Association, in session as this number is mailed, and the American Society of Municipal Improvement in October. The first and last named have been at work on this subject for some years and the Highway Association has fully recognized the importance of the technical questions by the large amount of space devoted to them in the program for its Detroit convention. It also devotes much time to the equally important subject of better road legislation.

This seems to be a year of more than usually valuable contributions, especially to our knowledge of the proper treatment of troublesome details and of satisfactory results therefrom.

The Fire Chiefs' Convention in New York in September offered over-

whelming evidence of the economy and efficiency of motor apparatus in fire departments, both large and small, and its contribution to our knowledge was upon the largest scale and upon the largest question, and is consequently of the greatest importance.

DEVELOPMENT IN BRICK PAVING INDUSTRY

The keynote of the Cleveland meeting of the National Paving Brick Manufacturers Association was co-operation. The association and the organizations of municipal officials have co-operated in the past to the extent of preparing standard specifications for brick and for brick pavements and the next step is to secure the co-operation of the city officials generally in adopting these specifications and in employing competent inspectors to carry them out. About one hundred city engineers from cities in Ohio and the states adjacent were present on invitation of the association and had this doctrine presented to them by other engineers and city officials and by ocular demonstration of the excellence of pavements constructed according to the adopted standards for material and workmanship.

It was suggested in the opening speech at the "get-together" banquet that the brick makers follow the lead of Mr. F. B. Dunn in putting engineers in the field to watch the progress of their brick after they have left the plant and offer their services in securing the best results with them. This offer was placed on the basis of the self-interest of the brickmaker, but would evidently give much valuable aid to contractor, engineer and inspector, and would thus be a concrete evidence of the desire of the makers of the material to advance the interests of all concerned.

A small group of members of the committees on specifications of the national societies visited several brick plants and streets under construction and saw the possibilities of preliminary inspection of brick at the plant. They also saw the need of uniformity and good judgment in inspection of materials and workmanship on the street and of workmanship equal in quality to the materials furnished in order to secure good pavements.

The conference will undoubtedly result in the wider extension of excellence in brick paving construction and in improvements of and benefit to the paving brick industry.

QUESTION DEPARTMENT

How to Fill Vacancy in Town Council.

Two of our town council having resigned, leaving three, all effort to get the three to agree upon some man to fill the vacancy has failed, two having been the means to have the other two resign in order to block all progress of the new administration. These two attempted and did elect one of their kind, which has been held by all but one or two attorneys here to be illegal, and our attorney general is in doubt as to its legality. There seems to be no Supreme Court decision on the point. Can you give any information?

R., Mayor, ———, Iowa.

It has been held that a city council cannot elect its own members when the law provides that they shall be elected by ballot by the electors of the city, in Kearney v. Andrews, 10 N. J. Eq. 70. But the Iowa statute, sec. 1272, p. 252, supp. of 1907, definitely provides for the filling of vacancies, in which it says that "in the office of councilman or mayor of any city and all other elective city offices, the council may appoint any qualified elector to fill such vacancy, who shall qualify in the same manner as persons regularly elected to fill such office, and shall hold such office until the qualification of the officer elected to fill such vacancy, who shall be elected at the next regular municipal election; in all town offices, by the council at its first regular meeting after such vacancy occurs, or as soon thereafter as practicable."

As to election of men to fill the vacancies, Thurston v. Huston, 123 Iowa 157, and cases from other states may be quoted as authority for the statement that, if there be no statutory restriction, a majority of a municipal council or board is a quorum, and a majority of a quorum may act. However, par. 2 of sec. 668 of the code provides that "in all cities and towns a majority of the whole number of (council) members, to which such corporation is entitled, including the mayor, shall be necessary to constitute a quorum." With five councilmanic positions and the mayor, four would be necessary to constitute a quorum and three votes would be necessary to secure a majority of that quorum.

Some doubt as to the application of Sec. 668 arises from the fact that Sec. 645 was amended in 1907 so that the mayor is no longer a member of the council, but Sec. 668 was not changed. It would seem that the mayor being no longer a member of the council would not be counted in determining a quorum, but Sec. 668 so requires.

Waterproofing Concrete Reservoirs —Cleaning Water Pipes

Have you any data or information on concrete reservoirs, especially with regard to waterproofing and expansion joints? One here, constructed about a year ago, does not hold water at all. I would also like to know the best methods for removing silt or sand from water pipe. Perhaps you could refer me to some book or paper that would cover these points. M., ———, Ore.

With reference to concrete reservoirs and making them water-tight the following references will be of value:

An article in MUNICIPAL ENGINEERING, vol. xlv, p. 54, on "Cracks in Concrete," gives the reasons for them and methods of preventing them, including the placing of contraction joints.

Methods of making elevated concrete tanks watertight are given in an article on "Construction of Two Types of Elevated Concrete Tanks" in vol. xliv, p. 62. The method of making a 5,000,000-gallon concrete reservoir hold water is indicated in a brief article on p. 79 of the same volume. Results of a test of the effect of a waterproofing compound will be found in an article on "Waterproofing Concrete Test," on p. 375. The method employed in waterproofing a leaky reinforced concrete water tank is described in detail in "Waterproofing Huntington Water Tower," on p. 470.

Three methods of waterproofing a concrete pit where water is coming in from

the outside under the outside pressure are suggested in vol. xliii, p. 175, and a successful method is given on p. 256. "Waterproofing of Swimming Pools," on p. 410, is more directly applicable to the case in hand, if waterproof lining of the existing reservoir is decided upon.

The construction of a covered reinforced concrete reservoir partly buried in the ground is described in vol. xlii, p. 42. In an article on "Economy of Circular Reinforced Concrete Reservoirs," on p. 376 of the same volume, is a description of the method of lining a leaky reservoir and adding to its depth, which resulted in a watertight reservoir of double the capacity. The waterproofing was very simple in this case, depending upon the proportions and mixing of the concrete and a wash of semi-liquid cement on the inside of the tank. A method of mixing concrete with a waterproofing compound is described in an article on "Integral Waterproofing" in vol. xlii, p. 416, and another will be found in vol. xli, p. 322.

Books on the subjects are not numerous. Lewis's "Waterproofing: An Engineering Problem" (50 cents) and "Modern Methods of Waterproofing" (50 cents) are valuable.

Lewis and Chandler's "Popular Hand-Book for Cement and Concrete Users" ($2.50) has a little information on watertight construction and waterproofing.

As to cleaning water mains, the best method, if possible to apply it, is to put in blow-off pipes at the lowest points in the lines with valves which can be opened to flush the mud and sand out into convenient water courses.

There are machines which can be operated to clean out water mains, but openings must be made into the mains at intervals to insert and take out the machine. One such machine is described in MUNICIPAL ENGINEERING, vol. xlii, p. 334, as made by the Turbine Sewer Machine Renovating Co., of Milwaukee, Wis. The apparatus as applied to a sewer is illustrated in an article on "Modern Sewer Cleaning in Milwaukee, Wis.," in vol. xliv, p. 273.

A scraper for water pipes is illustrated and described in vol. xiv, p. 232.

Water pipes can be flushed by opening hydrants, but where the flushing must be done frequently the hydrants to be used should be chosen carefully at the best locations to clean the troublesome sections of pipe. Valves can be set on these hydrant branches so that the hydrants can be removed easily for repair whenever they need it.

Procedure in Passing Ordinance

I would like to have the form of procedure for the passage of an ordinance where rules were suspended and the ordinance passed to its second and third readings at the same meeting, the form to comply with the Iowa statute. L., ——, Iowa.

Section 682 of the Iowa Code provides that "ordinances of a general or permanent nature and those for the appropriation of money shall be fully and distinctly read on three different days unless three-fourths of the council shall dispense with the rule."

The rule can only be dispensed with by a strict compliance with the statutory authority, so that two ordinances could not be included in the same motion, the action in such case being valid only as to the ordinance first named in the motion. Cochran v. McCleary, 22 Iowa, 75. It would therefore be safest to make two motions, one to dispense with the rule and place the ordinance on its second reading and the other to dispense with the rule and place it on third reading and its passage.

In State v. Vail, 531 Iowa, 550, it is decided that it is not necessary that the yeas and nays on a vote to suspend the rules requiring reading on three different days be recorded, and where a sufficient number of members to suspend the rule appear to have been present and such motion is declared adopted, it will be presumed that a sufficient majority voted therefor.

Danger of a similar attack would be avoided, however, by recording the yeas and nays on each of the motions to dispense with the rule as well as upon advancement of the ordinances to third reading and the passage of the ordinance.

In Bayard v. Baker, 76 Iowa 220, it is decided that the word suspend is equivalent to the word dispense, but it will be well to use the word dispense in the motions.

The membership of councils and what constitutes three-fourths of that membership are closely scrutinized and the statutes are strictly construed in such cases as Horner v. Rowley, 51 Iowa 620, and Griffin v. Messenger, 114 Iowa, 99. Section 645 of the code in its amended form provides that in cities the council shall consist of two councilmen from each ward and in town of five councilmen at large. Sec. 668, par. 2, providing that "in all cities and town a majority of the whole number of members to which such corporation is entitled, including the mayor, shall be neccessary to constitute a quorum," was not repealed or amended. These provisions are rather contradictory, but it would again be safer to count the mayor in the number of councilmen in determining the three-fourths vote necessary to dispense with the rule.

Other cases which consider various phases of the matter are: City of Eldora v. Burlingame, 62 Iowa 32; Strohn v.

Iowa City, 47 Iowa 42; Cutcomp. v. Utt, 60 Iowa 156; State v. Omaha & C. B. R. & B. Co., 113 Iowa 30; McGraw v. Whitson, 69 Iowa 348.

Road Construction for Heavy Travel

What is your opinion about hard country road construction As you well know, the modern heavy automobile with its monstrous tires makes terrible inroads on the country roads. Do you not think that these fellows ought to help pay a fair honorarium toward the upkeep of the various state roads? As you well know, a fellow cannot dance unless he pays the fiddler.

W. J., Aurora, Ill.

There is hardly a number of MUNICIPAL ENGINEERING which does not advocate hard pavements for the main roads, its theory being that the roads must be built to suit the traffic, and that the traffic on the main roads demands the best and most permanent wearing surfaces.

All of the items in the following statement have been elaborated in recent articles too numerous to mention in detail.

Such gravel and macadam roads as have been constructed in many states under the county and township systems, notably Ohio and Indiana, are sufficient for the local traffic about the farm, from farm to farm or from farm to main road, and it would be a waste of money to build them of better material. The automobile, if run at a proper speed, is a benefit rather than a damage to such roads, and a speed limit should be strictly enforced for all motor vehicles on such roads.

There is a class of what may be termed secondary roads which requires a somewhat heavier construction than the neighborhood roads and will demand this better construction more strongly in the future as the automobile truck develops as a carrier of farm products to market. These roads require heavier foundations and, on account of the likelihood of greater speed of vehicles, require some binder to keep the wearing surface in position and prevent the formation of dust. Various forms of bituminous treatments, bituminous macadam or bituminous concrete are suitable for most of these roads. These roads are worn out by general travel and the automobile rider from without the district does his full share of wearing them and he should pay his share of the expense of building and maintaining such roads, to be paid by the county and state from the proceeds of general taxes and automobile license fees.

There are a few main lines of road over which the traffic is now so heavy or will be so heavy as soon as the road is good enough to stand it, that only really good pavements, such as brick, cement concrete, or the best bituminous concretes are economical, when the first cost and the cost of maintenance are both considered. It is fairly evident that such roads enhance the value of abutting property, so it should pay a part of the cost of construction at least. However, much the greater part of the wear as well as practically all the necessity for so good a road arises from the traffic from territory not adjacent to the road, but even nation-wide, so it is equally evident that this traffic from outside and those who benefit from it should pay much the largest share of the cost of construction and maintenance. Contributions from county and state, derived from taxes, vehicle licenses, etc., are the only practicable means at present available for distributing this cost in any proportion to the uses made of the roads. It may even be contended that the United States should pay a certain proportion of the cost of thru routes of travel.

The automobile can be assessed more than any other vehicle because much of the demand for the best construction comes from the automobile users and their extended tours both for pleasure and for business. The automobile truck traffic is not yet as insistent in its demands, but its turn will come within two or three years, requiring stronger bridges, stronger road foundations and better road surfaces than gravel, macadam or like materials treated with bituminous materials by the so-called surface methods.

The wear upon the softer surfaces increases more rapidly than the speed of motor-driven vehicles, and probably more rapidly than the weight on motor trucks, so that it is certainly fair to assess such vehicles in proportion to possible speed and weight. The simplest method of covering both is to make the assessment in proportion to actual horse power available, as this is roughly proportioned to possible speed for the passenger vehicles and to possible weight for trucks. Motorcycles should be assessed in a different proportion to horse-power, because their speed is so much greater for the same horse-power than that of the four-wheeled automobile.

Proper Construction of Macadam Street with Concrete Curb and Gutter

I am interested in the making of water-bound macadam in a small city. I believe they are not doing substantial work. When the contractor rolled the macadam he spread and lifted the combination concrete curb and gutter, breaking it so that it had to be replaced. I am submitting a list of questions concerning methods of construction, and it may be you can cite references to articles already published on this subject.

1. Should the subgrade be rolled and to what extent?
2. If soft places are found in the sub-

grade is it worth while to dig out and replace with better material?

3. Is there any form of concrete combination curb and gutter that will hold its line and grade when the macadam is being rolled before placing the crushed stone?

4. Is it very material that the subgrade should be brought to a true and even surface by filling holes and dressing off humps before placing macadam?

5. Should the voids in the macadam be completely filled and how is the best way to accomplish this?

6. Can the binder or filler of limestone screenings be placed on top of 8 inches of macadam and be successfully rolled down thru, so as to fill the voids; or should it be mixed in two layers?

7. Should macadam be rolled wet or dry?

8. About how many days on the average should be required to properly roll a stretch say 26-ft. wide by 600-ft. long?

9. If there is a fill of over 1 foot should the filling be rolled in several layers with a steam roller? W., ———, Wis.

1. Ordinarily the sub-grade must be rolled. The weight of roller and the amount of rolling depend upon the character and condition of the sub-soil. In some cases a comparatively light roller produces better results than a heavy roller. In any event the rolling must be continued until the sub-grade is compact and to grade, uniformly thruout. The quotations of specifications made in the answers to the various questions are made from those adopted by the Association for Standardizing Paving Specifications and are styled the standard specifications. With reference to rolling the standard specifications provide as follows:

"Said completed surface, (after excavation) shall conform to the general cross-section of the street as indicated and shall be thoroly cleaned, all stumps, roots and sod or other vegetable matter removed, and the sub-grade shall be rolled with a steam road roller weighing ten tons, so the surface shall be exactly parallel with the proposed finished surface."

2. It is quite necessary to dig out soft places and replace with better material. This is especially true where trenches for water, sewer, conduit, etc., have been put thru the street before paving, and some specifications require that the rolling shall be done across the street as well as lengthwise in order to develop all soft places.

Professor Baker in his standard work on "Roads and Pavements," ($5), recommends, where the integrity of the pavement demands it, that trenches which settle under the rolling shall have the volume left after thoro consolidation filled with broken stone thoroly rolled to place or with concrete. The standard specification reads:

"All soft or spongy places shall be excavated and re-filled solidly with gravel, broken stone or approved earth before the completion of the rolling."

3. If the sub-grade is completely consolidated and the foundation and the earth behind the curb are consolidated as they should be, movement of the curb during the process of rolling is probably due to wrong methods of handling the roller. In very soft ground it would be difficult to hold the curb and gutter exactly to place, but in any ordinary ground on which a pavement may be expected to keep its place, the curb should keep its place. The standard specification reads as follows:

"The rolling herein specified must be generally begun at the curb or gutter line and rolled from curb to crown, the shoulders first being rolled so as to prevent the spreading of the stone."

The standard combined curb and gutter is 12 inches deep on the outside and extends 6 inches below the surface of the pavement plus whatever transverse slope is given the gutter surface. The broken stone, gravel, or cinder foundation of the curb should extend to or below the level of the sub-grade of the pavement.

4. The quotations, taken from the standard specifications, given above, provide first for the dressing of the surface until it is smooth and parallel to the finished pavement surface, and second for the rolling and dressing of this surface until it is thoroly compacted, smooth and parallel to the finished pavement surface. This is necessary that the pavement and its foundation be as uniform as possible, so that there shall be no unequal settlement or consolidation of either under traffic. The essential requirement of a macadam pavement is that holes shall not form in it, but that it shall keep a uniform surface. This is impossible if either compacting of foundation or compacting of the stone layer or hardness of the stone layer in place is not uniform.

The above sections were amended at a later convention to read as follows, making the requirement of character and form of surface still more exacting:

"The full width of the road-bed shall be brought to the proper line, grade and cross-section indicated on the plans by excavating, filling and thoroly rolling with an approved road roller weighing at least 10 tons; all soft or spongy ground shall be removed and refilled with gravel or other approved material which will pack, and the rolling shall be continued until the roadbed is thoroly consolidated and shaped to the satisfaction of the engineer. A wooden templet shaped to the proper size and crown of — inch per foot from center to side, or other equally satisfactory method, shall be used to obtain the required contours of all the courses. *Note.* The crown may be from ⅜ to ¾ inch per foot to be determined by the engineer for each particular case."

5. The standard specification deplores

the variety of specifications of sizes of stone and layers and suggests the following, the stone being separated by screening thru stone screens with circular openings ⅜-inch in diameter producing screenings, 1 inch in diameter, producing so-called ⅝-inch stone, and 3 inches in diameter producing so-called 2-inch stone, and using all the product of the quarry except that refused by the largest holes.

"The lower course shall consist of run of crusher stone which shall pass a 3-inch and be retained on a 1-inch screen. The stone shall be laid upon the properly prepared foundation to a depth of 4 inches when completed. The depth of the loose stone in all cases shall be fixed by laying upon the sub-grade cubical blocks of wood of the proper size and spreading the stone evenly to conform thereto. This course shall be thoroly rolled until the stone does not creep or wave ahead of the roller. Stone screenings or sand shall then be uniformly spread over the surface in small quantities by shovels from carts or piles of filler alongside the road and the rolling continued, sweeping in the screenings meanwhile until no more will go in dry, when the surface shall be well sprinkled by an approved sprinkler to fill the voids, screenings being added where necessary and the rolling continued until the surface is satisfactorily finished. No filler shall be left on the surface, but the surface shall be left with the clean stone projecting for a bond, leaving the lower voids thoroly filled. *Note.* Upon a poor foundation or where a finished depth of stone of more than 4 inches is deemed advisable, the stone shall be laid in two layers and treated as above described. Good results may be obtained without filling the voids in the lower course, but upon a sandy soil or a well-drained roadbed better results seem to be obtained by thoroly filling the voids in the stone. Stone screenings, sand, or other suitable material may be used as a filler. Good results may be obtained by a sand filler, and results are also obtained when a small quantity of stone screening dust is used on top of the sand to fill the voids in the sand. The voids may be filled without application of water if all the materials are dry; but a firmer foundation seems to be secured when the course is well puddled with water. In some cases properly screened gravel may be used as a bottom course and as a filler in the top and bottom courses."

6. The specification just quoted also answers the sixth question, in effect that if the macadam is to be 8 inches thick it should be laid and rolled in two 4-inch layers and each layer filled with screenings or only the top layer.

7. The seventh question is also answered by the above quotation, providing for dry rolling followed by wetting and rolling.

8. The amount of rolling depends so much on the kind of stone, hard stone requiring more time, the amount and kind of filler required and the amount of water used that no figure of direct application can be given. Applied to the data given for length, breadth and thickness, actual measurements on jobs show variations from 3 to 27 days' time required, the average being about 6 days, but this average may be quite different from the time required on any one job.

9. The more thoroly a fill can be compacted the better. The New Jersey specifications provide a maximum thickness of layer to be rolled of 12 inches. Again the thickness of layer and the amount of rolling depends so much upon the kind of earth used in filling and its condition, particularly as regards moisture, that this specification for New Jersey sandy soil might not suit the soil in the particular case.

Drainage Water in City Sewer

I have received the following communication:

"I have eighteen acres of land drained by farm tile, which empties into the city sewer. This 7-inch tile runs a small stream of water into the sewer all the year. From your practical knowledge of such things, would you say this water was an injury or a benefit to the sewer? I am thanking you in advance for a line or two expressing your opinion."

So far as our experience goes we believe the introduction of clear water, in reasonable quantities, would be a benefit to the public sewer system operating under conditions which prevail in most Illinois cities of 5,000 to 10,000 population.

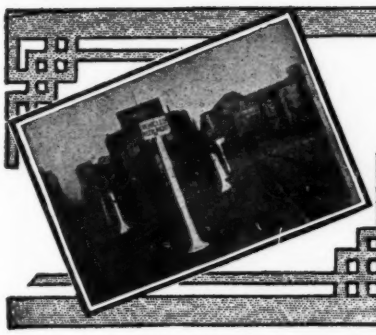
What, from your experience and observation, do you think of the proposition?

D., Mayor, ———, Ill.

In cities of the size mentioned a constant discharge of clear water into the sewer is a benefit rather than a damage, provided purification of the sewage is not required. In that case the demand is for as small a flow as possible, that the expense of the process of treatment may be as low as possible.

At times during the day the flow of sewage is probably slight and, especially in the branch sewers, there is possibility of collection of solids enough to obstruct the sewer, and flush tanks are supplied in some systems to give intermittent streams of clear water of considerable volume.

It would be possible, of course, to overload the sewer with the stream of clear water, but, up to that point, the clear water is a benefit. To insure provision for future increase in amount of sewage, any permit to use it for drainage purposes should be revocable at any time.



WORKERS IN THE FIELD

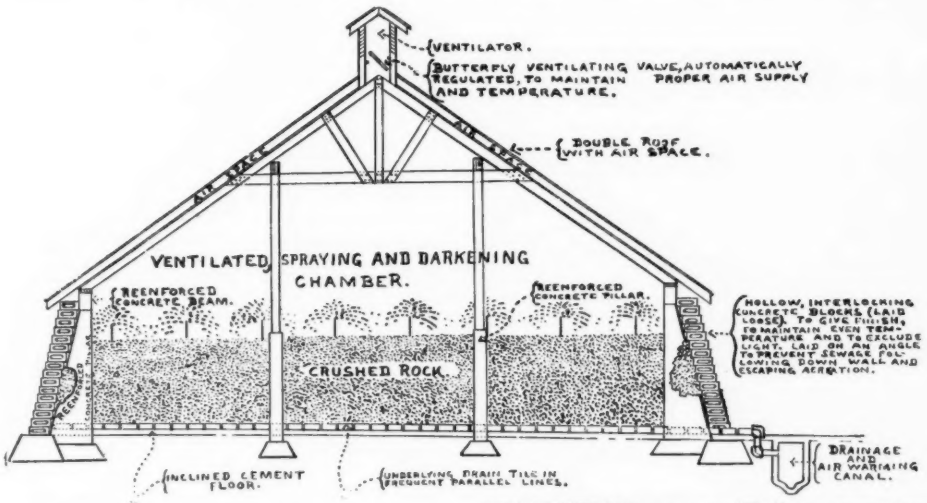
Suggestions for Improvements on Bacterial Filtering Beds for the Purification of Sewage

The Editor of MUNICIPAL ENGINEERING:

Sir—After a careful study of sewage purification for Pasadena, I would like to make the following suggestions public through your pages. They may possibly be of use, especially where the climate is less equable than here.

These suggestions apply to a filtering bed of the usual construction for the purification of sewage, consisting of an inclined concrete floor on which is a series of parallel rows of drain tile over which is a bed of broken rock or other mineral material in pieces of graded sizes, and placed above the broken material are sprinklers or other means of applying the sewage effluent of the Imhoff settling tanks in a regulated and approximately even manner over the entire surface of the bed.

1. Over the bed of crushed mineral material, an enclosed "ventilated spraying and darkening chamber" in which said sprinklers are located as shown in accompanying drawing. The purposes of the proposed chamber are: a.—To maintain the desired equability of temperature on the surface of the bed of filtering material; b.—To regulate the air ventilation of the bed; c.—To control the admission of sunlight on the surface of the bed; d.—To protect the bed against any unusual washing by rain, the object of the chamber being to maintain conditions best suited to the bacterial growths necessary for purification of the sewage-effluent.


VENTILATOR.
BUTTERFLY VENTILATING VALVE, AUTOMATICALLY REGULATED, TO MAINTAIN PROPER AIR SUPPLY AND TEMPERATURE.
DOUBLE ROOF WITH AIR SPACE.
AIR SPACE
VENTILATED SPRAYING AND DARKENING CHAMBER.
REENFORCED CONCRETE BEAM.
REENFORCED CONCRETE PILLAR.
HOLLOW, INTERLOCKING CONCRETE BLOCKS (LAID LOOSE) TO GIVE FINISH, TO MAINTAIN EVEN TEMPERATURE AND TO EXCLUDE LIGHT. LAID ON AN ANGLE TO PREVENT SEWAGE FOLLOWING DOWN WALL AND ESCAPING AERATION.
CRUSHED ROCK.
REENFORCED
INCLINED CEMENT FLOOR.
UNDERLYING DRAIN TILE IN FREQUENT PARALLEL LINES.
DRAINAGE AND AIR WARMING CANAL.

SUGGESTION *for ventilating, warming and darkening filter beds to supply uniform conditions and stimulate bacterial action.*

2. In the "ventilated spraying and darkening chamber," an automatic thermo regulating device for operating a ventilating valve or damper. The purpose is to open the valve further when the chamber

is warmer than necessary and to close it further when the temperature of the chamber falls below that under which bacterial life is most active; always bearing in mind the fresh air needs of such bacteria. The device should, of course, be so adjusted in regard to temperature and ventilation as to produce the best average results. However, to effect a finer adjustment of ventilation and temperature, it is suggested that an automatic air-warming device be installed. This would permit the temperature and ventilation to be regulated more independently of each other. In this case, the air-warmer would be regulated by the temperature of the chamber, while the ventilating valve, instead of being regulated by the natural temperature of the chamber, would be governed by the velocity of air escaping thru the ventilators.

3. An automatically regulated air-warming mechanism for the "covered, ventilated drainage and air-warming mechanism" is for the purpose of maintaining a more ideal temperature in cold weather at the base of the filtering bed. The ends of the parallel lines of underlying drains are extended into the canal, and thru the latter the air needed for bacterial growth passes into the drains and rises thru the mass of broken mineral material into the "ventilated spraying and darkening chamber," thence escaping into the open air thru ventilators in the roof.

The action of such a filtering device doubtless would have greater capacity per cubic yard of crushed contact material, and would be more uniform and reliable in its action. Much of the chance for odor, such as occasionally develops in filtering beds of ordinary construction when the bacterial action is disturbed and weakened by unfavorable weather conditions, would, it is fair to assume, be eliminated by the use of a filtering device where conditions for bacterial growth are kept constantly normal. To overcome this occasional odor is one of the main purposes of these suggestions.

In preparing a filtering plant of this kind, it might be better to have the depth of broken rock somewhat greater than usual and the rock particles slightly larger in size. This plan will give slightly freer ventilation, while the active contact surface would not be diminished. If the air is warmed in cold weather, this freer ventilation will not result in cooling the mass of rock to a point where bacterial action would be retarded.

If what is above described has already been tried, information regarding the experiments would be thankfully received by the writer of these suggestions.

WILLIAM THUM,
Pasadena, Cal.

Better Inspectors Needed in Chicago

The Editor of MUNICIPAL ENGINEERING:

Sir—The committee on downtown streets of the Chicago Association of Commerce is co-operating with the Board of Local Improvements of the City of Chicago in securing the best possible quality of work for the money expended. Whenever we detect defects in paving material or construction we immediately report same either to the inspectors in direct charge of the work, or in case of more serious errors we make report to the Board of Local Improvements at the city hall. In this work cordial relations have been established.

If all of the work now contracted for and contemplated is completed during the present working season, the city of Chicago will have exceeded all previous records for paving construction. It is estimated that there are about 150 miles of pavements to be constructed during the working season. In 1911 the city of Chicago constructed about 130 miles of pavements. With so many miles of pavements being constructed each year, one may well wonder when the time will come that all of Chicago's streets will be paved. The answer is, "Never." At present only about one-half of the streets of Chicago are paved. Long before the unpaved ones can be improved a large number of those now paved will have worn out, so that each year Chicago will have to construct many miles of pavements to take care of its ever-increasing traffic.

INTELLIGENT inspection essential to good pavements. In order to secure competent inspectors they must be well paid and assured continuous employment.

One of the greatest difficulties in the way of securing the best paving construction possible in Chicago is its method of inspection or supervision of the work. The proper construction of a pavement is dependent almost entirely upon the work of the sub-inspector. The general inspector, because of the fact that he has a large district to cover, can spend but a short time upon any particular piece of work. This being true, it is necessary that the sub-inspector be a man of intelligence with a thoro understanding of the technic of pavement construction. It goes without saying that such men cannot generally be obtained without the payment of an adequate compensation and the assurance of steady employment, so that each man may have an interest in his work and with a knowledge of the security of his position show a proper independence of spirit.

The plan now followed in Chicago violates these fundamental requirements. In the first place, while the compensation received by the inspectors would be adequate if they were employed for the full year, it is totally inadequate because of the fact that the men are only employed during the paving season, which means that they actually work about seven months a year. In the second place, while the men are nominally under civil service, the real object of civil service is defeated by the "sixty-day appointment rule," which allows the alderman the right to certify any man for employment as paving inspector for a period of sixty days. This sixty-day appointee is required to take no examination or in fact know anything about paving construction. At the end of sixty days the appointee may take an examination for paving inspector. Even tho at the end of sixty days he may pass the examination for paving inspector, think of the mistakes he may have made in the meantime, for all of which he is being paid by the city.

To secure the best results it is our opinion that the city must raise the requirements of paving inspectors, provide them with yearly employment, and abolish the "sixty-day appointment rule." There is nothing about the present plan which will attract good men or which will tend to keep good men in the service. Many inspectors simply regard their work as a job to be held until some better opportunity occurs.

L. A. DUMOND, Engineer,
Chicago Association of Commerce.

New Jersey Requirements for Sewerage and Water Supply Plans

The Editor of MUNICIPAL ENGINEERING:

Sir—At a recent meeting of the Board of Health of the State of New Jersey, a set of rules and regulations governing the submission of designs for water works or sewerage works were adopted. These rules have been under consideration for about a year, and the necessity for them has increased daily. Plans are submitted at the present time in all sizes up to 6 feet by 10 feet, and on all kinds of paper from the wrapping kind up to tracing cloth.

It is also an unfortunate circumstance that some few engineers who have worked along other lines will accept work designing municipal sewage disposal or water purification plants apparently without investigating the underlying principles as thoroly as is desirable. It then becomes necessary for the State authorities to gather detailed data regarding the project, which very often cannot be done as efficiently as would be best, because of the small number of engineers which may be employed with the present annual appropriation.

The present rules are therefore intended to prevent loss of time incident to the collection of fundamental data, upon which the design is based, and also to make the plans and reports more uniform in character.

Before taking final action upon the regulations they were submitted to several of the leading sanitary engineers, with the request that comments and criticisms be made. It was the intention of the board to see that no unjust provisions should be included which would cause unnecessary expense or hardship upon the part of the engineers. Many helpful suggestions were made by these engineers, and the board desire to express their appreciation of the time and trouble which were taken in making the replies.

The regulations were prepared by C. G. Wigley, engineer of the board, under the supervision of R. B. Fitz-Randolph, chief of the division of food, drugs, water and sewerage, and adopted by the board of health of the state of New Jersey, June 23, 1913.

R. B. FITZ RANDOLPH.
Chief of Division of Food, Drugs, Water and Sewerage, State Board of Health, Trenton, N. J.

RULES and regulations to be followed in the preparation of designs for sewerage and water supply systems.

An abstract of the "rules and regulations for the preparation and submission of designs for sewerage systems and sewage disposal works and water supply and water purification systems" follows, showing the more important requirements, and may serve also in some measure as a guide in preparing designs, plans and specifications where the state does not have close supervision of such matters:

The plans for a complete sewerage and sewage disposal system shall include:

A general map of the municipality or sewerage district.

Profiles of all sewers proposed.

Details of construction of manholes, flush tanks, and special structures pertaining to the sewers.

General and detailed plans for disposal works.

A comprehensive report upon the proposed system by the designing or consulting engineer. This report to be typewritten upon letter-size paper, and the sheets firmly bound together.

The general plan scale shall be from 100 to 300 feet to 1 inch, and shall show the entire area of the municipality or

district. If the municipality is greater than two miles in length the map may be divided into sections, the sheets bound together and a small index may supplied.

This plan shall show all existing or proposed streets, the surface elevations at all street intersections, and contour lines at intervals of not more than 10 feet.

If it is intended to defer the construction of sewers in some of the streets, the plan shall show that sewerage facilities are provided for all such sections of the municipality or sewerage district. The plans shall also clearly show the location of all existing sewers, either "separate" or "combined," the location of the disposal works, and the location of existing and proposed sewer outlets or overflows. The true or magnetic meridian, the town or borough lines, title, date, scale, direction of flow and average water elevation of the stream shall also be clearly shown. The elevation of the highest known freshets at the outlets and site of the disposal plant shall be given. Any area from which sewage is to be pumped shall be shown by light shading, coloring or other distinctive marks.

Profiles of all sewers over 8 inches in diameter and of all 8-inch sewers, where gradients less than that given below are used, shall accompany the application.

STANDARDS for the making of profiles, detail drawings, reports, etc., for sewers.

Profiles of sewer lines shall be prepared and drawn to such a scale as to clearly show the structural features of the sewer. For ordinary use, the following scales are suggested: Vertically, 10 feet to 1 inch; horizontally, 100 feet to 1 inch. Both scales must be clearly shown upon each sheet. Upon these profiles shall be shown all manholes, flush tanks, lampholes, siphons, and stream crossings, with elevations of stream bed and normal water. Figures showing the sizes and gradients of sewers, surface elevations, sewer inverts, etc., should be shown with the same frequency as required for the map.

The following gradients for sewers flowing half full are suggested as minimum grades for ordinary use, as with careful construction a theoretical velocity of approximately 2 feet per second can be obtained:

Size of pipe.	Fall in feet per 100 feet of sewer.
8 inches	0.40 feet
10 inches	0.29 feet
12 inches	0.22 feet
15 inches	0.16 feet
18 inches	0.12 feet
20 inches	0.10 feet
24 inches	0.08 feet

The sewers should have a capacity when flowing half full sufficient to carry twice the future average flow twenty-five years hence, plus a sufficient allowance for ground water infiltration.

When grades lower than those given are used, an explanation and reasons for the use of such grades should be included in the engineer's report.

Detail drawings of sewer sections except where terra cotta or iron pipe is used, and of all sewer appurtenances, such as manholes, lampholes, flush tanks, inspection chambers, siphons and any special structures, shall accompany the general sewer plans.

The plans for the disposal works shall include a general plan upon which reserve areas or future extensions are clearly shown, and detail plans of the various units and structures which comprise the plant.

A weir or other measuring device shall be provided at some convenient point, and the installation of a recording device is recommended, and in particular instances may be required.

The detail plans shall show longitudinal and transverse sections sufficient to explain the construction of each unit. They should also show the distributing and drainage systems, general arrangement of any automatic devices, sizes of stone, gravel, or sand used as filtering material, and such other information as is required for the intelligent understanding of the plans.

All drawings submitted shall be neatly and plainly executed and may be traced directly on tracing cloth, printed on transparent cloth, or printed on any of the various papers which give distinct lines. All prints shall be clear and legible.

With the exception of the map, the following dimensions are suggested for ordinary use: Distance from top to bottom, 20 or 30 inches; length, 24 inches, 32 inches, 40 inches or 48 inches, or thereabouts. By this section it is intended to prevent the use of long profiles and unnecessarily large maps, which are difficult to file or to use.

A report, written by the designing or consulting engineer, should accompany all plans for complete sewerage systems, and shall give all data upon which the design is based, such as:

The nature and extent of the area which it is proposed to include within the present system of sewerage, and of the area which it is planned shall ultimately drain into this system.

The population to be served, both present and estimated for twenty-five years hence.

The estimated per capita daily flow of sewage to be cared for.

The total and per capita water consumption of the town at the present time.

The allowance made for leakage into the sewers.

The estimated daily flow of sewage, including leakage.

The character of the sewage (whether domestic or including manufacturing wastes, and in case of the latter, the nature and approximate quantity of the same stated in specific terms).

Method of flushing or periodically cleaning of sewers.

That portion of the sewers to be built at the present time.

The minimum grades of sewers for each size used.

If there are sections which cannot drain into this system, the extent of such sections and the probable future disposition of the sewage from these sections.

Distance of sewer outlet from shore and depth of water at mean tide at outlet, if outfall discharges into ocean or large stream.

A list of bench marks or fixed elevations should be included in this report.

RULES for design of sewage disposal plants, with full instruction for procedure in collection of data.

With regard to the disposal plant, the engineer's report shall cover the following subjects:

The method of disposal to be adopted and a description of the units of the system.

The rate of working of each unit.

If disinfection is to be used, the name of the disinfecting substance, the quantity per million gallons of sewage and the method of application.

The nature of the body of water into which the effluent discharges, with particular reference to the run-off during dry weather.

The disposal of sludge.

All conditions peculiarly characteristic of the locality and which in any way affect the design of the system.

Special devices used in connection with the disposal system.

Specific methods of maintenance or operation of the system.

The results expected from the purification system.

Explain any provisions for reserve units in pumping plants, pipe lines, filters, etc.

Specifications for the construction of the system of sewers and sewage disposal works and an estimate of the cost of the same shall accompany plans.

Under ordinary circumstances the board will approve such plans only when designed upon the separate plan, in which all rain water from roofs, streets and other areas and all ground water, other than unavoidable leakage, is to be excluded.

No by-passes which may allow raw or partly purified sewage to be discharged from the sewers or disposal works shall be included in the plans, except by special permission of the board.

No deviation from approved plans shall be made, unless amended plans, showing such proposed changes, have been submitted to and approved by the board.

The rules governing submission of plans for water supply and water purification systems are similar, the most important provisions applying only to water supplies being as follows:

A report, written by the designing or consulting engineer, shall be presented with all plans for complete systems, and shall give all data upon which the design is based or which is required for the complete understanding of the plans.

Where a purification or treatment plant is to be constructed, a measuring device shall be provided at some convenient point, and the installation of a recording device is recommended, and in particular instances may be required.

If no purification process is provided, the nature and extent of the watershed, with special reference to its sanitary condition, shall be fully and explicitly discussed, together with proposed methods and regulations for the prevention of accidental or other pollutions.

A small scale map of the watershed, showing the roads and the number and character of buildings, shall be included in the report. Other features which should be discussed in the report are: Storage capacity, average depth, general nature and area of the storage reservoir, liability of odors or tastes in supply, and removal of color, iron, or hardness.

If the water supply is to be taken from wells, describe the number, depth, size and construction of the same; method of pumping, capacity of pumps, kind of strainer used, nature of ground thru which wells will be driven, and probable flow of the wells. If collecting galleries are to be used. describe their construction.

INFORMATION required for design of water purification plants.

The following information is required respecting the purification plant: The method of purification and a description of the units of the system; the rate of operation of each of the systems; the rate of operation of each unit of the plant; if any chemicals are used, the nature and quantity of each with a description of the appliances for adding the same to the water; a description of all conditions peculiarly characteristic of the water or lo-

cality which in any manner affect the design or operation of the system; a description of all special appliances used, any special methods of maintenance or operation of the plant, and the extent of purification expected or guaranteed.

If for purposes of fire protection it is necessary to provide by-passes, by which partly treated or raw water can be turned into the mains, they shall have valves upon them of such a character that they may be properly sealed by the state board of health. These valves shall not be opened except in accordance with the provisions of Chapter 317, Laws of 1912.

The report should further include a description of the nature and extent of the area to which it is proposed to supply water, or which will ultimately be supplied from the system, the quantity of water to be supplied daily, and the population to be served, the portion of the system to be constructed at present and the minimum depth of pipe below the surface of the ground. A description of any provision for future units of pumping plants, filters, etc., should be given.

Should there be areas in the municipality or district which, on account of topography or for other reasons cannot be supplied with water, a definite statement to this effect must be made and the probable future supply of this omitted territory should be discussed.

Removal of Projections Over Sidewalks in Chicago

The Editor of MUNICIPAL ENGINEERING:

Sir—Until recently there were many show-cases, fruit stands and projecting board signs in the central business section of the city, commonly called the "loop" district. We have caused the removal of all of these and of all obstructions of like character in the downtown section outside of the loop, and in outlying business centers where such obstructions could be construed as nuisances.

We do not issue permits for stands to be placed within the street lines in the loop district, nor in outlying business centers where such structures would interfere with the passage of pedestrians on the sidewalks.

We do not issue permits for any projecting signs other than electric in any part of Chicago. Projecting electric signs are provided for by ordinance, in compliance with which we approve applications and the city electrician issues permits. However, we forbid the erection of projecting signs of any kind on State street between the Chicago river and Harrison street, and on Madison street between the lake and the Chicago river.

An ordinance provides that canvas awnings must clear the sidewalk by at least 6½ feet. This ordinance is rigidly enforced. There are few awnings in the section of Chicago bounded by the river on the north and west, the lake on the east, and 12th street on the south.

The worst form of sidewalk obstruction with which we have to deal is one we inherit from the architects who planned the rebuilding of the city's business blocks after the great fire of 1871. Many, in fact most, of the old buildings are so constructed that the lower floors are below the grade of the walks. The buildings are built to the street line, and to reach these "half-basements," as we term them, an area of four or more feet is cut from the walk adjoining the building. The same condition prevails where basements of old buildings are used for business purposes. The custom of a few years ago was to make one floor below the street grade an income producer for the property owner.

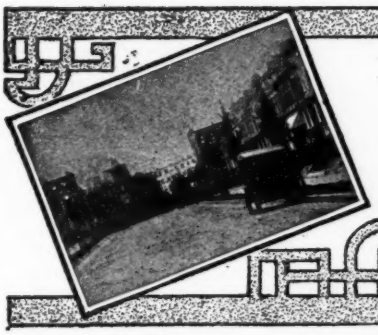
When an old building is remodeled we compel the owner to construct the front so that these areaways are closed, and the full width of sidewalk space is restored for use as such by the public. We do not issue permits for such use of walk space in front of new buildings. Modern buildings are all constructed so that the full width of walk, unobstructed by either depression or riser, is available for passage by the public.

There is an order of the city council which provides that all obstructions on walks in the loop district must be removed before January 1, 1915. We will during next year serve notices on all owners of projecting windows, areaways, risers, etc., to comply with the provisions of this order, and believe that the enforcement of its terms will greatly facilitate foot traffic and add to the comfort of this city.

F. W. SOLON,
Superintendent of Streets, Chicago, Ill.

Sanitary Drinking Cup

The department of health of Harrisburg, Pa., has approved of a paraffined paper drinking cup, which has a flap which can be inserted in a slot, and thus close the folded cup so that dust cannot get into it. The cup is then put in a small paper envelope and can be carried in the pocket. Thus the cup can be used several times before it wears out. On the outside of the envelope is printed, "Drink from your own cup and avoid contagion. This sanitary drinking cup can be used many times. Use it and assist the Department of Health, City of Harrisburg, Pa., to prevent diseases."



ROADS AND PAVEMENTS

Manufacture of Paving Brick from Furnace Slag.

An extensive industry is being developed in the north of England, at Middlesborough, in making paving brick of blast-furnace slag, several companies being engaged in the work and apparently very successful.

A suitable manufacturing site is connected by an industrial railway upon which the molten slag is carried from the furnace to the molding machine. The latter consists of a metal wheel which may be of any suitable diameter, approximately 30 feet, this wheel being supported upon a vertical shaft. The spokes of the wheel are made of rods and the wheel itself is quite similar to the wire-spoked wheel used for vehicles. The rim upon which the molds are bolted is approximately ¾ inch thick and 6 inches wide, and carries 120 molds, 9 inches long, 3½ inches thick and 4 inches deep, which is the standard size for paving brick. The molds are made of two pieces, the front end or right side being an arm in one piece which is bolted to the rim of the wheel, while the left side, back end, and bottom is another piece. The latter is hinged to the part which is secured to the rim of the wheel and held for casting purposes by a catch on the front end of the stationary piece. On the right side of the mold is cast a lip which assists the operator in more readily striking the mold when pouring the hot slag. Before casting, the molds are dusted with a cement powder.

The car which carries the slag is of plate steel with a firebrick lining, the top being covered over with a removable cap, in the center of which is a hole approximately 18 inches in diameter, thru which the slag is poured when the car is filled at the furnace. At the bottom of this car is a tap similar to those used upon blast furnaces. The car of molten slag is run alongside the wheel, the trough to the tap extending over the molds; the clay plug in the tap is knocked out and the molten slag runs into the mold. As soon as it is filled an operator, by means of a handwheel mounted upon a sheet-steel heat deflector and connected thru rods and miter gears to the center of the molding wheel, turns the latter so that the next mold comes under the flow of hot slag, and so on until all the molds are filled. By the time the wheel has made a quarter revolution the cast brick have sufficiently cooled so that they may be dropped out of the molds by knocking off the catch which holds the bottom in place.

As soon as they have dropped to the ground they are taken by laborers to the annealing furnaces, into which they are thrown in a promiscuous heap. These furnaces, of which there are six, hold approximately 1,100 brick at one charge. The heat retained in the brick when they are thrown into the furnace, together with a very small amount of fuel, again brings them to a cherry red, and as soon as the furnace has been filled it is closed and allowed to cool gradually, twenty-four hours usually being required before the bricks are removed.

The capacity of the slag car is approximately 3½ tons, from which 360 to 400 paving bricks are made. The bricks, when cleaned up, having all of the rough corners knocked off which have been left in the process of casting, weigh about 14 pounds each. These bricks are proving very efficient for street paving and are being exported to the United States, Canada, and many other foreign countries.

Concrete Road Organization

By G. F. Haskell, The Concrete Construction Co., Cedar Rapids, Ia.

A good plan of organization for carrying on concrete road work is to divide the work into two parts, each under a competent foreman or superintendent, the first party to do the grading, prepare the subgrade carefully and haul the aggregate on the road bed in such quantities that there will be sufficient to provide for the concrete. It is better, however, to have

slightly less than too much aggregate in the roadway, as it is more economical to haul in an extra load or two to make up any deficiency that may occur than to dispose of a surplus.

It should be borne in mind for estimates for this part of the work that there will inevitably be a small amount of aggregate left on the road bed, which is by no means a bad feature, so that there should be allowed a full cubic yard of gravel or stone for each cubic yard of concrete to be laid.

The second party comes upon the work with the concrete mixer and starts in at one end of the road to mix and place the concrete. With an automatic distributing boom type of machine five to seven men will be about all that can be used advantageously in shoveling the material into the hopper. Two men will be required on the machine, one man to clean up as the machine advances so that the concrete may be placed on a clean roadbed; two or three men taking up the forms as used and putting them ahead; three men to strike the work, using the template and two men finishing with floats. Parties so made up, with a 12-foot capacity mixer, will ordinarily lay from 500 to 800 square yards of 7-inch concrete a day of ten hours; 500 yards can be laid with a comparatively untrained crew, or a trained crew should handle 700 or 800 yards. The teams necessary for this part of the work would be only those required to haul the cement and an occasional load of gravel as deficiency may be experienced.

There are sections of the country where continued sultry summer weather prevails when it will be necessary to work the shovelers in two gangs, working from fifteen to twenty minutes each. Either this must be done or the progress of the whole party reduced to about one-half what it is in cooler weather.

A third party might be organized to trim the shoulders and attend to final finishing of the side roads and ditches.

In those sections of the country where the rainfall is plentiful and well distributed thruout the year, it will be found that the actual number of working days in which it is possible to lay bituminous macadam in some seasons will prove few indeed. There will be a somewhat longer period in which waterbound macadam can be placed, and a still longer period under the same weather conditions that concrete construction may be carried on. This is explained in that with concrete construction, after the roadbed is prepared, which will be done for the full length of the road or at least for a considerable distance, the subgrade is immediately covered with the gravel or stone to be used, and even tho it may become subsequently wet, it helps rather than retards the condition of the concrete. Whereas, a wet sub-base in macadam construction, either waterbound or bituminous, will prevent the use of a roller and delay seriously the progress of the work.

STREET *paving in Clarinda, Ia., work being done by the Concrete Construction Co., Cedar Rapids, Koehring street paving mixer in foreground.*

Like all other forms of road construction, if the concrete road is to give proper service, it must have proper maintenance. Just what it will be necessary to do to maintain properly a concrete road cannot now be entirely foreseen owing to the limited experience with this form of construction.

Most uneven places in concrete roads are started by the formation of a crack, the edges of which will become broken

down under traffic. That a crack forms shows that there has been movement of the concrete, and doubtless the cause resulting in the cracks still exists. If the cracks should become filled with incompressible material either by pouring in a thin grout or gradually filled with dust and grit from the road, there is every likelihood that the crack will extend under subsequent movement of the concrete slab.

It is believed that it is important to leave the concrete surface free to move as it shows by the appearance of cracks that it is necessary for it to do. Therefore, as soon as cracks are formed, and a sharp lookout should be kept for them, they should be cleaned out as thoroly as possible and filled immediately with some plastic material, such as an asphalt pitch. This will prevent water seeping through the cracks and also offers considerable protection to the edges, especially if the crevice is flushed with a slight excess of the pitch.

In the maintenance of concrete roads all expansion joints should be kept carefully under observation, and as soon as there is evidence that the plastic material has been worn away, as will happen during hot weather when it is squeezed out, it should be replaced and the cracks not allowed to become filled with hard material.

We have recently finished one good-sized contract at Clarinda, Iowa, using this machine, also two good-sized contracts at Cedar Rapids, for cement paving along with some curb and gutter work. The most advantageous feature of the new Koehring street machine is the 30-ft. boom with which we have our machine equipped, which allows us to lay sections without moving the machine and without skipping and going back. This is a great labor-saver and time-saver. The machine will mix when loaded to its capacity repeatedly almost to call it a continuous mixer. It takes 25 seconds for the boom to fill, swing out and come back to its place. It takes 15 seconds to load the machine from the elevator. There are many advantages that can only be arrived at by seeing this mahcine work. The mechanical arrangement and assembling of the machine is such that the working parts are practically perfect and are all protected and covered so as to keep the splash of concrete from getting into the cogs, etc.

California Highway Improvements

By Roy M. Horton, Engineer for San Joaquin County, California, Highway Commission.

In planning the proper road to be built in any location, the future cost of maintenance should be taken into consideration. If it happens that a source of good material is available, which can be obtained for maintenance at a low cost, it may sometimes be desirable to plan the roads so that the local material can be used. Where there is no cheap supply of material for maintenance, and where the traffic justifies building a road at all, it should be built with an idea of keeping the maintenance cost as low as possible.

In this country there are in general two locations where a good supply of local material is available and where, considering the fact that the county cannot raise the money at the present time to put in a pavement which will not need maintenance, the best course to pursue is to plan the roads so that the natural materials can be used in the future for maintenance. One of these locations is on the roads extending from Woodside to San Gregorio, and the other is on the road near Crystal Springs lake, west of San Mateo.

PERMANENT good roads dependent largely upon grade. Grades prepared so that they will be good for half a century.

The grading is the most permanent thing about a road, and before money is expended upon any type of surfacing for a road, the grade is prepared in a manner which will make it useful twenty-five or fifty years from now. It is a waste of money to place expensive surfacing materials upon a temporary grade. The grade is one of the most important considerations of the proposition, because the grade is there for all time and our successors should find the grades which we build in such condition that they will need to put no further expense upon them when they find it necessary to change or renew the surfacing of the roads. Therefore, no matter what type of pavement, expense is not spared on the grades.

On the roads which receive the heaviest traffic, those lying along the bay side of the county, the grades are constructed to a width of at least 30 feet, so that ample room for turn-outs may be afforded. On the mountain roads the width of grade can be safely made less than 30 feet, because of the lighter traffic and the lessened speed of vehicles. On the most important of the mountain roads, the grades are not less than 24 feet in width. Twenty or 22 feet are very satisfactory widths for grades and there is no danger when vehicles meet on grades of these widths.

In regard to the widths of the road, it has been demonstrated that a surfacing 15 feet in width, is, for all ordinary

traffic, just as serviceable as one which is 16 feet in width. Two automobiles or two ordinary horse-drawn vehicles can pass with just as much ease on a 15-foot pavement as they can on a 16. Only extraordinarily wide roads would experience difficulty in passing upon 15-foot pavement. Therefore a good many of the roads are planned to be 15 feet in width. A few are planned to be 14 feet in width. Fourteen feet is the narrowest width on which two ordinary vehicles can pass with ease.

ROAD widths between ten feet and fourteen are uneconomical.

The 12-foot road is not recommended because it is wider than is necessary for one vehicle, and not wide enough for two. If it were found necessary to cut the width of road less than 14 feet, it should be made 10 feet rather than 12. The road will cost less and be just as serviceable.

The estimates include connecting the state highway thru the different incorporated cities which it touches, and constructing the main county roads in four municipalities, the town of Burlingame having been omitted because that municipality has already let a contract for improving the portion of the county highway which lies within its corporate limits, and Daly City being omitted because the state highway commissioner will undoubtedly include the paving of the main street as a part of its contract on the mission road.

The estimated costs of improving the county road lying in the four municipalities referred to, included in the tabular summary of estimates for the proposed bond issue, are in detail as follows:

In Redwood City, length 9293 lineal feet. Pavement to be constructed to a width of 24 feet with gravel shoulders 7½ feet wide on each side. The pavement is estimated at 16 cents per square foot, including grading, and the total cost is estimated at $39,885.

In the city of Hillsboro, the length is 1,214 lineal feet. The pavement is to be constructed 24 feet wide at a cost of 16 cents per square foot and the gravel shoulders 7½ feet wide are to be built on each side. Total estimated cost, $4,662. The old macadam road on the present road can be used for shoulders in the city of Hillsboro.

In the city of San Mateo the length is 8,026 lineal feet. The pavement is to be constructed 24 feet wide at a cost of 16 cents per square foot, including grading, making a total of $30,820. The old macadam on the present road can be used for shoulders.

In South San Francisco, the length is 9,300 lineal feet. The road is planned to be 20 feet in width at 15 cents per square foot, not including grading. Gravel shoulders are to be constructed for the full width of the grade on each side. The cost of grading within the city limits is estimated at $10,480, making a total cost within the city limits of $43,180.

ESTIMATED COST OF PAVEMENTS FOR BOND ISSUE.

Road	Miles	Grading	Total
Bay Shore	5.12	$ 25,650	$ 106,746
Hillsboro-Halfmoon	11.54	32,240	85,625
Belmont to Lakes	6.0	14,000	52,080
Woodside Road	5.64	4,500	71,252
Woodside-W. Creek	9.00	45,000	84,424
W. Creek-San Gregorio	10.87	15,000	54,322
Menlo Park Road	3.28	5,000	37,310
Middlefield Road	3.40	4,000	42,238
Colma-Halfmoon	28.96	91,000	285,054
Halfmoon-Pescadero	21.37	57,700	132,224
Redwood	1.76		39,885
Hillsboro	0.23		4,662
San Mateo	1.52		30,820
South San Francisco	1.76	10,480	43,180
	110.45	$304,570	$1,069,822
Bridges and culverts			100,000
Rights of way			25,000
			$1,194,822
Plus 8 per cent			95,586
Total of estimate			$1,290,408
Recommended for bond issue.			$1,285,000

AVERAGE COST.

	Miles	cost Total	mile Cost per
Grading	110.45	$304,570	$ 2,757
Gravel roads....	32.24	112,538	3,490
Macadam roads..	25.04	77,389	3,090
Asphalt roads...	53.17	575,325	10,820

MAJORITY of contractors have awakened to the value of up-to-date labor-saving equipment.

On account of the length of haul and the character of the roads the majority of the contractors now deliver the bulk of the materials in 7-ton Port Huron steel dump cars drawn by Port Huron road rollers. Many of these cars and road rollers are employed in this service. The rollers draw one, two or three dump cars, depending on the condition of the road over which they travel. The average train is three to five cars to the roller. It has been demonstrated that these trains are operated just as fast as a good team can walk under similar conditions. They are stated to work better than teams except where the road is muddy. The cost of hauling with the rollers and cars also has been found to be less than when teams were used.

Even patent dump wagons which do not spread evenly while dumping are now out of date for distributing material in the work of constructing macadam, gravel, etc., roads; and farm wagons with slat bottom boxes are greatly behind the times for doing such work. Compared with self-dumping, non-spreading dump wagons, Port Huron cars save in spreading alone 2 or 3 cents a cubic yard (depending upon the price of labor) as against hand raking, and 3 to 4 cents as against shoveling from platform. Compared with farm wagons with slat bottoms, these cars save from 2 to 5 cents a cubic yard (depending upon the price of labor) in dumping and spreading stone, etc., on the road bed.

Creosoted Wood Block Pavement in Longview, Texas

By P. E. Green, Assoc. M. Am. Soc. C. E., Consulting Civil and Sanitary Engineer, 17 N. La Salle St., Chicago.

Longview is a typical Southern city of east Texas. It has a population of 8,000 and is growing very rapidly. It has never had any considerable amount of public improvements until within the last year or two, when some macadam pavements were constructed outside of the business center of the town. These macadam pavements were constructed on entirely wrong principles, so that in less than a year they were in bad condition. In the spring of 1911 the city decided to pave the central business district of the town with a permanent pavement, and on August 11, 1911, received bids on approximately 17,000 square yards of brick and creosoted wood block pavement on 5-inch concrete base. The specifications called for No. 1 brick, to have a 2-inch sand cushion, and the joints to be filled with asphaltic cement, and the wood block to have a 1-inch sand cushion and the joints to be filled with sand.

The low bid for the brick was $2.35 per square yard, including a five-year guarantee; for the wood block the bid was $2.41 per square yard, under the same guarantee. The specifications for the brick called for a 20 per cent. abrasion test in the new standard rattler, as recommended by the Association for Standardizing Paving Specifications. The wood block specifications called for yellow pine timber, the blocks to be from 5 to 10 inches long, 3 inches in depth and 4 inches in width. The preservative specified was the best grade of coal tar creosote, having a specific gravity of from 1.03 to 1.07 and to contain not less than 25 per cent. of naphthalene and 25 per cent. anthracene.

The sand used for the bed for the blocks was a fine local sand, carrying considerable clay. It was well suited for the sand bed, since it would stand a very considerable washing, such as it would receive in a rainstorm. It was observed that after a heavy rain lasting twenty-four hours there was but little sign of washing of such sand as was exposed, and that during the entire time of the rain the water draining off from this sand bed ran clear.

Yellow pine having annular rings averaging not less than eight to the inch was specified for the paving blocks, and in no case were the annular rings to be less than six to the inch, measured radially. Such a specification called for a very good grade of lumber. Considerable difficulty was found, however, in maintaining this standard, as a great deal of the timber shipped by the manufacturer had four or less rings to the inch and was probably a poor quality of short-leaf pine. The six-to-the-inch standard was rigidly maintained, with the result that the amount of culls was 7 per cent., or nearly 1,100 square yards. These culls were afterwards used in paving an alley where the wear of traffic would not be so great.

Part of the wearing surface was laid during hot, dry weather, and this afforded

a very good opportunity for observing effects of expansion and bleeding. Expansion joints 2 inches wide were made at each curb line, the roadway being 70 feet in width; no transverse expansion joints were used. As has been stated previously, the filler for the pavement was sand, thoroly swept into the joints, and the expansion joints themselves were filled with asphaltic cement. As originally planned, the blocks were to be laid from gutter to gutter, at right angles to the roadway, but at the request of the contractor he was allowed to lay two longitudinal courses of blocks at the gutter line and divide the expansion joints between the two courses. When the work was half finished it was evident that this was a mistake. These longitudinal joints are not bonded or keyed to the rest of the pavement and have little power of resistance to transverse pressure. The asphaltic filler tends to get slightly under them, and the expansion taking place across the roadway forces the longitudinal blocks up. The asphalt would then be forced still farther under them, making it difficult to get the blocks into their original position. It was then decided to return to the original method of laying the blocks, and no further trouble was experienced from this source.

In the center of one of the streets was an antiquated horse-car line. On account of the financial condition of the company owning the line it was impossible to provide new rails, and the old rails consisted of a T-section of about 20-pound weight. The blocks were laid between the rails, and it was in this location that the only real trouble from expansion occurred. These blocks bulged along the entire line of the railway, and repeated repairs seemed to do no good. Between the rails there was no provision for expansion, as it was not thought possible that within the short width of the gage (4 feet 8½ inches) expansion would be noticed. It was finally decided, however, that the very light rails were deformed by the pressure from the outside, and this pressure, being thus transmitted to the blocks between the rails, caused them to rise up.

Two details of construction aided to bring this condition about, and this incident also serves to show how the best of plans sometimes fail because apparently minor details are overlooked. It was originally specified that a special street car brick be laid against the inside rails. On account of the lightness of the rail section it was not possible to get the special brick, and hence it was decided to lay the wood block directly against the rail. The rail was 3 inches high, and necessary depth to be allowed on the head for the wheel flange was ¾ inch. Hence the end block had to be chamfered on the bottom so that at its end it could have a depth of 2 inches, leaving ¼ inch depth for the mortar bed. A section across the pavement between the rails would then show a flat arch, the rise being ¾ inch. As has been stated, no appreciable expansion was expected. The end blocks might have been beveled on top instead of at the bottom, but the objection to this was that the fresh surface of the timber would be exposed to the weather and traffic. Later experience showed that this would have been better, for it was the arched section which developed weakness under the pressure from the outside blocks, as might have been expected.

An expansion joint was made down the center of the track by cutting individual blocks and filling them with asphaltic cement, and no further trouble was experienced from this source.

Recut Granite Block Streets in Schenectady, N. Y.

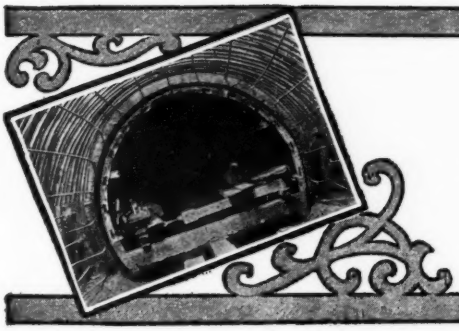
Sections of State street, in Schenectady, N. Y., have been paved for years with granite blocks of about 12 by 4 by 8 inches dimensions. The city is now relaying these streets, by taking up the blocks, cutting them into smaller sizes, about 6 by 4 by 4 inches, and re-dressing them and laying the smaller blocks. Where the old foundation was not of concrete a 4-inch concrete foundation is put in and the blocks are set in the wet concrete, the joints are filled with cement grout and the surface is flushed with the same. The work is done by city labor and with the concrete foundation is costing about $1.50 a square yard. It is evident that the granite blocks when thus cut into the smaller sizes will lay double the area of pavement, and when the surplus from one street is laid to replace a wearing surface on another street, the concrete foundation being already in place, the cost is about $1 a square yard.

Charles A. Mullen is the superintendent of public works who is thus doubling the city's granite block surfaces.

Slag for Concrete Curb and Gutter

By Chas. L. Marsh, City Engineer, Gadsden, Ala.

I have used a basic slag for concrete curb and gutter for five years. I can find no fault with it. No sign of any stain or disintegration on any of it. I use this slag in all arch work up to 15 feet in diameter. It has proven good, and is about one-half as costly as stone.



SANITATION

Institutional Disposal Plant of Infirmary and Children's Home of Greene County, Ohio.

By A. Elliott Kimberly, Consulting Engineer, Columbus, O.

In my opinion sewage purification plants for State and County institutions are of unusual interest.

The plants for the Infirmary and for the Childrens Home of Greene County, near Xenia, O., serve 100 and 75 persons respectively.

Since filters constructed of fine grain material for sewage are more effective than other primary filtration procedures in removing organic matters, and since their operation is simple, such plants appear best adapted to the sewage treatment needs of the smaller institution. Moreover, the cost of filtering material, while relatively high in regions where the glacial drift formation is absent, does not usually prevent the use of filters of fine grain because of cost as might be true for large institutions or for small municipal plants.

In view of the above considerations, intermittent filters of fine grain material were alone considered for these Greene County plants. In broad terms, the plans provide for the interception by a screen of the coarser matters present to an unusual extent in institutional sewage, removal by sedimentation of a part of the suspended matter and oxidation of the dissolved impurities by intermittent sand filters to which the sewage is applied intermittently, automatically and in considerable volume.

The screened sewage enters a covered reinforced concrete settling tank 4 feet by 10 feet in plan, with a flow-line depth of 6 feet. The capacity of the tank is about 1,800 gallons, which affords a period of retention of 11 hours at the maximum capacity of the plant. A manhole is provided for entrance to the tank. Sewage enters the tank thru a cast iron elbow extending to a point 2 feet 6 inches below the flow line, and flows out over a weir plate 6 inches in length and placed on the center line. Cypress baffle boards are located 3 feet from the inlet and 9 inches from the outlet end, and extend 3 feet 9 inches below the flow line.

FILTRATION *bed, Xenia, Ohio, which receives the discharge from the settling tank through a Miller alternating five-inch siphon.*

Contiguous to the settling tank is a covered dosing tank 7 feet 9 inches square in plan. It is constructed of reinforced concrete. A manhole is placed in the roof to give access to the siphons. The tank is operated by 5-inch alternating siphons, of the Miller type, set to

draw 4 feet. With no allowance for inflow, the discharging capacity of the dosing tank is about 1,800 gallons. Independent discharge lines of 6-inch vitrified sewer pipe conduct the sewage to an influent chamber whence it is applied to the sand filters.

The sand filters are each 38 feet square in plan. The surface area is 1,444 square feet or 0.033 acre each. They are separated by a concrete wall, the other three sides of each unit being formed by embankments sloping 1½ to 1. The filters contain 3 feet 6 inches of sand supported by a graded gravel layer of 6 inches maximum thickness. The effective size of the sand actually placed in the filters is 0.23 m.m.; the uniformity coefficient 1.8. Each filter is drained by two lines of 4-inch vitrified sewer pipe leading into a main drain 6 inches in diameter. The lateral drains are laid with open joints and with an open space of about ½ inch between the lengths of pipe. The bottom of the excavation is sloped to each drain and equal areas are tributary to each lateral drain.

The necessary feature of intermittent operation of sewage sand filters is, of course, well understood. This feature is usually obtained by providing a dosing tank with automatically operated siphons. These devices insure the application of a volume of sewage sufficient to cover practically the entire area of the sand surface. In the writer's experience, the direct flooding of sand filters at institutions (dosing tank omitted) is not advised because the rate of flow varies within wide limits and at night practically ceases. The directly flooded filter remains in service a given number of hours after which the sewage is diverted to another filter. This feature entails or should entail more or less continual and intelligent supervision, a departure from the original premise regarding simplicity and ease of operation.

The sand filter is the most successful of all types of plant for the small institution where there is desired a well-putrified, stable effluent. In fact, such filters can be considered to advantage even for institutions of from 1,000 to 2,000 population. Of course, the question of cost will largely control for the larger places, where the problem really approximates that of the small municipality. Whether the choice be contact filters alone or in combination with sand filters or possibly sprinkling filters, simplicity should be the keynote of the design.

All automatic apparatus for these installations was furnished by the Pacific Flush Tank Company.

Facts About Collection of Garbage and Refuse

The average weight of garbage in cities is 1,150 to 1,475 pounds per cubic yard. The average weight of mixed rubbish and ashes is 800 to 1,100 pounds per cubic yard. In summer ashes form one-third the mixture and in winter three-fourths. The actual weights vary in different cities and in different districts in the same city, according to fuel used, whether rubbish is burned in stoves, habits and wealth of citizens, etc., so that a city must be divided into districts for collection purposes according to these variations as determined by a careful study.

A garbage collector requires an average of 3 minutes to remove the garbage from a house, half this time being consumed in getting into and out of the houses, so that a back-gate collection will require much less time. He travels 2¾ to 3 miles an hour and visits 40 to 90 places in an eight-hour day.

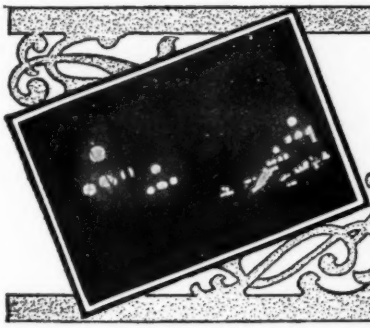
Collection by teams is the cheaper but hauling the full load to disposal plant by motor is the cheaper.

The garbage produced per capita averages from 175 to 225 pounds per annum, rubbish and ashes 325 to 530 pounds. Street sweepings amount to about 1/3 cubic yard per capita.

Mixed collection of all garbage and refuse costs less than separate collection. The mixture of all refuse is cleaner to handle, prevents fly breeding and lessens dust from ashes. The can for separate garbage collection is liable to become a greater nuisance than frequently collected garbage.

Free Garbage and Refuse Collection in Schenectady, N. Y.

The city of Schenectady, N. Y., began, about September 15, the free collection of garbage and refuse. The ordinance requires every householder to procure a standard garbage pail and ash can, and the city has made arrangements to supply these cans at the lowest possible cost. The decision last summer that the city could not engage in the ice business prevents the supply of the cans by the city directly, and an arrangement has been made by Commissioner C. A. Mullen with a large department store, H. S. Barney Company, to supply the cans at the same low prices, made possible by the size of the order. That the prices are low is shown by the list: Garbage pail and cover, 7-gallon, 50 cents; 10-gallon, 60 cents; 12-gallon, 70 cents; ash can and cover, 16-gallon, $1.60; 24-gallon, $2; 32-gallon, $2.40, delivered.



FIRE AND WATER

Maintenance of Fire Department Grounds

By W. E. Bideker, Chief Fire Department, Fort Worth, Tex.

The last three years have witnessed the development in Fort Worth of a remarkable phase of civic beautification—the transformation each summer of the grounds surrounding the fire halls into garden spots planted with a variety of shrubs and flowers.

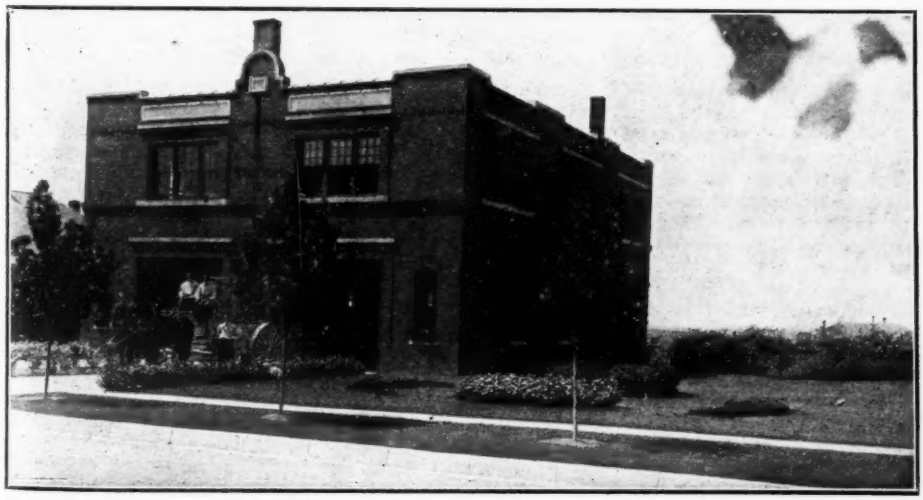
Beds of white and red coleus or verbenas and pink and white coleus laid out carefully in many shapes and sizes, dozens of rose bushes planted symmetrically about the lawns or along the sides of the station buildings, together with trellises of honeysuckles and hedges of castor beans have combined to effect a complete and wonderful transformation.

In several instances that have come to my attention, the improved appearance of the fire hall grounds has proved a potent example to nearby residents. Emulating the firemen, these citizens have trimmed their own ragged lawns, planted rose bushes and a few flowers and have trained vines over their front verandas. Some of them have even given their houses a coat of fresh paint.

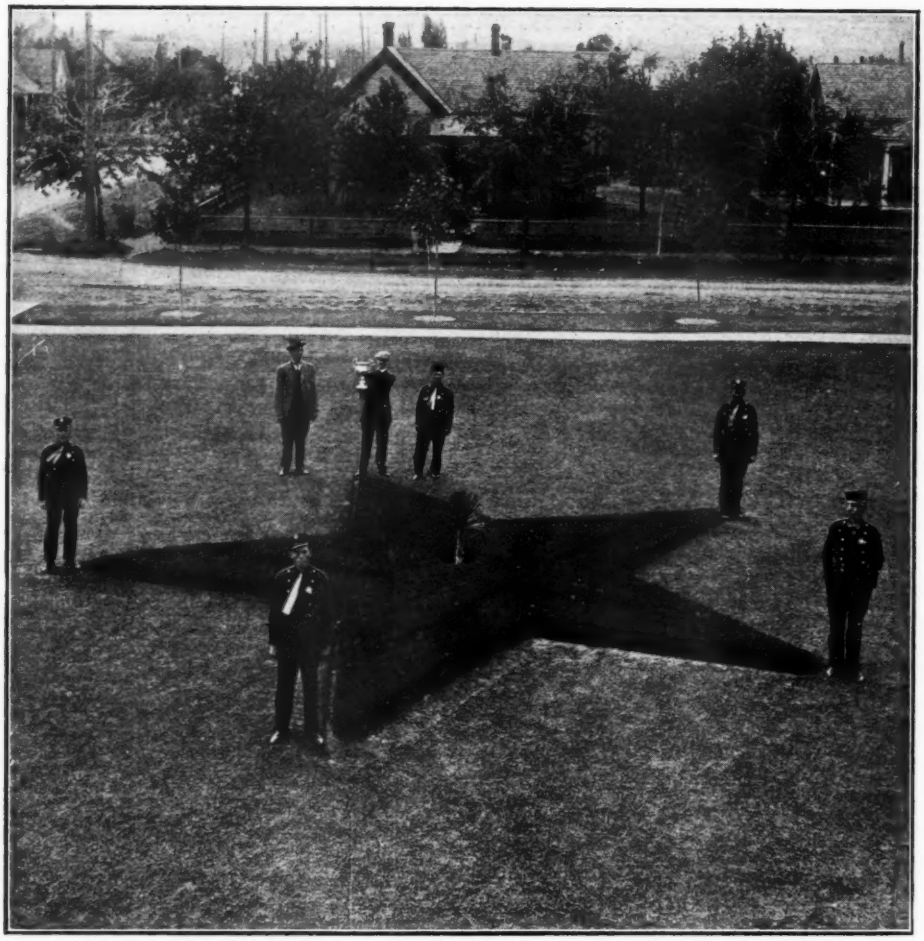
The movement has resulted in the appearance each summer in the windows of the fire halls and the homes in their vicinity, of green-painted "garden boxes." Thruout the summer these miniature gardens planted with Wandering Jew, the dew plant and asparagas sprengari, have been things of beauty, their trailing vines set off to excellent advantage against the stone and brick of the buildings. Intense rivalry, increasing year by year, has marked the efforts of the firemen-gardeners.

The movement for the beautification of fire hall grounds had its inception in the spring of 1910, when a local paper launched its first flower garden contest.

Considerable preparation was made for the contest. Assistant Chief Ferguson, an enthusiastic and expert amateur gardener, was called upon to furnish designs for



NUMBER 10 *fire station, Ft. Worth, Tex., showing the possibilities of beautification of stations.*



WEST LAWN *fire station No.* 13, *which won the Costan cup for two consecutive years,* 1911 *and* 1912.

beds; Lieut. John Black, of Station No. 7, now captain of Station No. 13, superintended the work of his men, with the result that the coveted cup went to No. 7.

The experience gained by the contestants proved exceedingly valuable to those who essayed to win the cup the ensuing two seasons. It was found that the red and white coleus planted in neatly arranged beds made an exceedingly pretty picture, when set off by the green of the clustering alternatheras used as a border plant.

The second year of the contest witnessed several additions to the list: No. 13 fire station, Hattie and Buxton streets, commanded by Captain Black, promoted from No. 7, came into the limelight with a bound. In spite of the handicap which the men were forced to overcome in the way of extra work necessary to get their grounds into shape, they won the Costan cup handily.

Station No. 12, Prospect between Twenty-fourth and Twenty-fifth streets, on the north side, and Station No. 8, Lipscomb and Bellevue, also became contestants. Well arranged beds were laid out, breaking the monotony of lawns which had formerly been maintained about their buildings.

The announcement of the 1912 contest witnessed the active participation of every one of the thirteen fire halls in the city, with the exception of No. 1, Second and Commerce, and No. 11, Twelfth and North Main streets, on the north side. Surrounded by cement sidewalks, laid close to the building, affording no space for planting flowers or a lawn, No. 1 was debarred from entering the contest, except by means of window boxes. Its men

made the most of their opportunities last spring, however, and succeeded in producing some "handkerchief gardens" that were the admiration of the judges in the floral contest.

Firemen at No. 11 station have been unable to secure any results in their attempts to grow flowers owing to the gravelly nature of the soil in their vicinity. They too, planted several pretty window boxes.

Under the direction of Captain Black, the men at No. 13 laid out a vinca bed in front between the sidewalk and the curbing and planted rose bushes at the sides of the building and between the driveways. On the west lawn there was a star-shaped bed of green and red flowers, with a border of alternantheras. Other smaller beds were laid out and a trellis work of honeysuckle placed at the back of the building to the east and north.

Such careful and artistic effort did the firemen here display in preparing their grounds that they won the Costan cup for the second time.

Floral displays at the various stations resulting from the contest, elicited many favorable comments from visitors during the summer months. A delegation from the National Association of Fire Engineers which passed through on their way to the Denver convention, were especially impressed and complimented Chief Bideker highly.

Water Meters as Handled by the Water Meter Department

By Otto F. Poetsch, Superintendent of Meters.

Water meters in the city of Milwaukee are furnished at the expense of the consumer. All services are required to be metered. The total number of meters set up to January 1, 1913, is as follows:

All the public buildings, fire houses, patrol stations, natatoriums, etc., as well as the large public parks, were metered during 1912, all work having been done by the meter department. As a result, the water department will be able to ascertain the actual amount of water consumed at these places in the future.

The following is a summary of the work done in 1912, compared with 1911, which shows the increase of work to be 24 per cent. over that in 1911:

	1911	1912	Increase
Meters in service	55,291	57,657	2,366
New meters tested	2,719	2,768	49
New meters set	2,320	2,383	63
Large meters retested on premises	160	176	16
Meters examined and repaired in shop	6,650	8,950	2,300
Meters examined and repaired on premises	5,128	6,260	1,132
Meters requiring new repair parts	2,739	4,846	2,107
Total amount of meters handled	14,657	18,154	3,497

The inauguration of a systematic manner of testing of meters in service by the meter department and the repairing and readjustment of same to secure an accurate registration, is one of the important features of a survey or investigation of water service of the city and will greatly assist in future work of this division.

The work of putting in the service and making connections for meters is done by licensed plumbers, the city inserting the tap and the plumber continuing with the work after the tap has been made. When ready to have a meter installed, he delivers the meter to this department and makes written application, on Form No. 1, supplied by the department.

SIZE.	Worthington	Niagara.	Badger.	Neptune.	Keystone.	Thomson.	Worthington Disc.	Hersey.	Nash.	Union.	King.	Worthington Turb.	Neptune Crest.	Standard Disc.	Westinghouse.	Crown.	Nile.	Hersey Torrent.	Fajen.	Gem.	Eureka.	Hersey Detector.	Standard Current.	Trident Comp.	Empire.	TOTAL.
⅝-inch	13163	13203	8772	3392	3415	3223	1989	2363	1898	57	8	..	..	38	27	16	..	..	3	..	..	..	..	..	1	51,568
¾-inch	966	555	1255	219	247	154	357	111	123	39	5	..	..	..	4	4	..	..	..	..	..	..	..	..	..	4,039
1 -inch	362	78	70	72	25	50	68	22	31	40	16	..	..	..	..	4	..	..	..	..	..	..	..	..	..	838
1¼-inch	..	4	9	..	1	..	18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	32
1½-inch	172	33	20	28	9	8	35	2	3	29	6	1	..	..	..	1	..	..	..	..	1	..	1	..	..	348
2 -inch	148	58	61	18	6	9	57	3	1	18	17	5	3	..	..	..	..	..	..	..	..	..	..	..	..	404
3 -inch	134	..	28	9	7	9	17	3	1	12	..	16	8	..	..	..	8	1	..	2	1	..	..	1	..	257
4 -inch	35	..	19	6	6	1	4	2	..	9	1	20	21	..	..	2	3	1	..	1	..	..	..	1	..	132
6 -inch	4	..	..	..	1	1	..	..	..	3	..	5	6	..	..	3	..	2	..	..	1	1	1	..	..	28
8 -inch	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	2	..	..	..	2	..	..	..	5
10 -inch	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	4
12 -inch	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Totals	14984	13931	10234	3744	3716	3455	2545	2506	2057	207	53	49	43	38	31	30	11	6	3	3	3	3	2	2	1	57,657

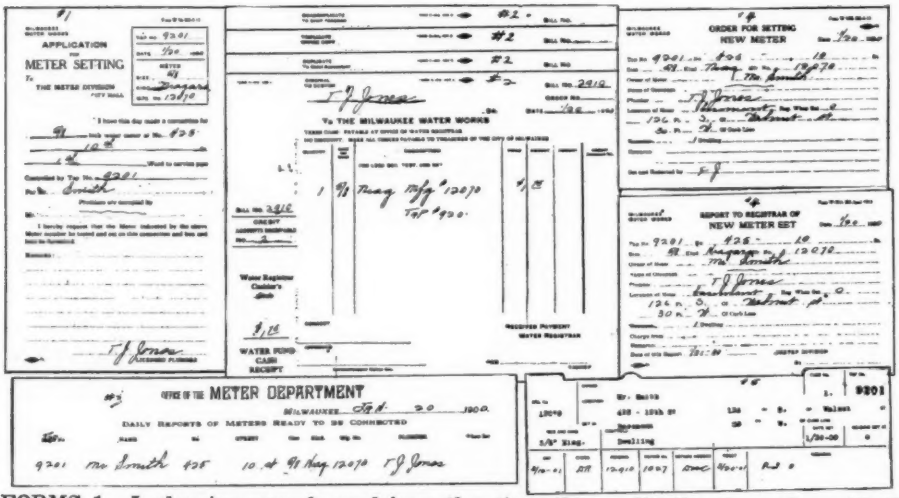
CHART *showing different kinds of meters and sizes in use.*

Upon receiving this application, which shows the tap number, owner's name and location, size and kind of meter, a bill for the testing and setting, which is done by this department, is made in quadruplicate form, which is payable in the office of the water registrar.

After the charges for testing and setting have been paid, the meter is listed on sheet No. 3, ready for setting. From this list setting orders are made out on Form No. 4. This is made in duplicate form, the original remaining in the office and the duplicate going to the shop foreman, who checks out the meter and has it set by the meter setter. The meter setter sets the meter and makes out report of the location and what the meter controls on the duplicate setting order. The duplicate is then returned to the office and the original filled out. The original then goes to the water registrar, as a report of new meters set, in order that an account can be opened and the meter thenceforth read monthly. A meter record card, Form No. 5, is also made out at the same time and becomes a permanent record of the meter at all times. This card, as will be seen, gives full data for the meter; also space is provided for any further transactions, so that the card at all times shows the complete history of the meter from the date it was first installed to the present day. This card is filed according to tap number in a special filing case. With the use of the guide cards any record card can be had in a few seconds. Cross reference index of manufacturer's number to tap number is also made and filed according to manufacturer's number, showing the size and kind of meter and tap number so that the record of any meter can be readily found, should one turn up with only the factory number on it. The forms Nos. 1 to 5 are shown in the group in the first of the accompanying cuts.

A house number index, from which the tap number can be readily gotten, is also maintained by the water registrar, to which this department has easy access, thus making it possible to locate any meter by either the tap number, manufacturer's number, house number or lot and block number.

After the meters are installed they are read monthly by the meter readers. If, while taking their monthly readings, a meter is discovered out of order, same is reported by them. A field order, Form No. 6, is made out. All leaks and dirty dials reported on field orders are repaired on premises. These meters reported as not registering or where the consumption is questioned are ordered off and brought back to the shop. When a meter is brought into the shop a "Meter Take-Off and Resetting Order" is made out, Form No. 7. This is made out in duplicate form. These orders are put in an assembling tray and taken out when routed on route list, Form No. 8. This list is given the meter men, who take off these meters and bring them into the shop, reporting the reading for same. This list is then returned to the office in order that the "Meter Take-Off and Resetting Order" can be properly filled out. The original is then sent to the water registrar in order that he may make proper entry on his meter card. A duplicate is sent to the shop and goes on the meter and remains with the me-


APPLICATION
METER SETTING
THE METER DIVISION
ORDER FOR SETTING NEW METER
REPORT TO REGISTRAR OF NEW METER SET
THE MILWAUKEE WATER WORKS
OFFICE OF THE METER DEPARTMENT
DAILY REPORTS OF METERS READY TO BE CONNECTED

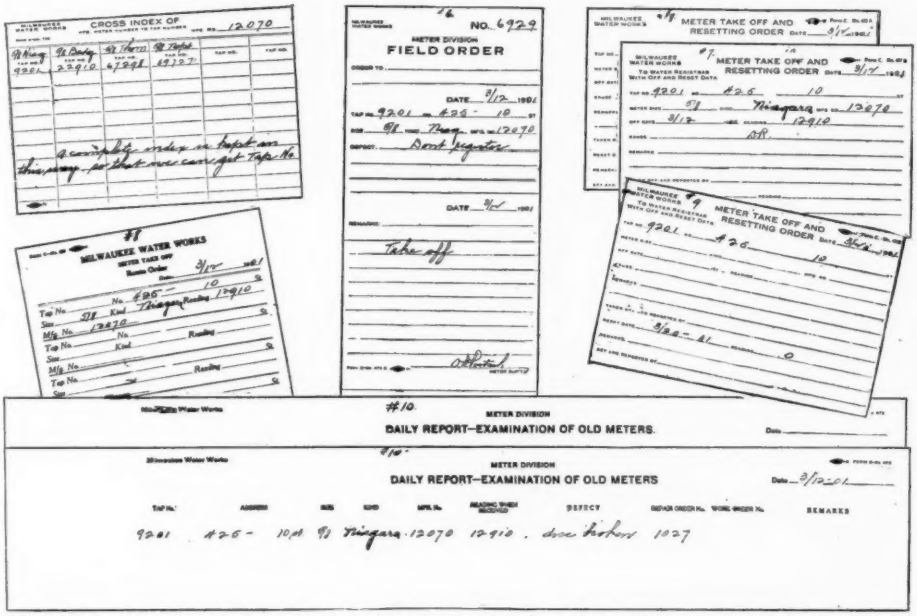
FORMS 1—5, *showing records used from the time the application is made until the meter is set.*

ter until it is reset. The off record is also noted on the meter record card, Form No. 5, so that a record of same is had in this office.

After the meter has been repaired and reset the duplicate "Take-Off and Resetting Order," Form No. 7, is returned to the office, entered on the meter record card, Form No 5, and reported to the water registrar on Form No. 9. During the time that this meter is off a connection pipe is inserted and the water averaged for the period that the meter is off.

Every meter as it comes into the shop is listed by the stock clerk on Form No. 10. The cross index blank and Forms 6 to 10 are shown in the second cut.

If the meter requires any repairs a stock room is made out on Form No. 13, which shows on what work order or repair order each item was used. This sheet goes to the cost clerk daily, in order that it can be transcribed or posted on his copy of the repair order. The cost clerk also gets the time sheet of each man, in order that he can post the time spent on each job to its respective order. In this manner the cost clerk in the accounting department posts the repair parts used and the time spent in repairing on any particular order. When a job is completed a bill for same is made out. The cost clerk also keeps a card record stock account of all meter parts, materials and supplies. These are checked out on his cards by him, as the



FORMS 6—10, *cross index of manufacturer's number to tap number, field order, meter take-off and reset order, and daily report on old meters.*

work order is made out by the stock clerk in triplicate form, the first being used as office copy and for non-chargeable work. See Fig. 11. The pink order or second copy goes directly to the cost clerk in the accounting department. The triplicate, which is printed on a card, is sent with the notice, Form No. 12, to the owner or occupant for signature. Upon being returned this order is sent to the shop foreman, who has this meter repaired upon this signed order. The order also acts as an order to get repair parts from the stock clerk, who enters same on the order and also checks out of the stock the parts delivered on this order. Forms 11 and 12 are shown in the third cut.

A daily report of all parts leaving the stock leaves the stock room. All new stock purchases are reported on Form No. 15, which goes to the cost clerk, in order that same can be entered on the stock records. At the end of each year an inventory of stock according to stock cards is taken, which must agree with the physical inventory of parts in the stock room. Forms 13, 14 and 15 are shown in the fourth cut.

Practical demonstration made on auto trucks and a tabulated record of work done by horse teams convinced us that it would be beneficial to replace horse teams with auto trucks.

The following tabulation shows the work done by four teams for five and one-half days. It shows the number of jobs attended to, the actual time used in team-

ing to the jobs and return and the actual working time spent in taking off or setting meters.

ONE WEEK'S WORK WITH FOUR TEA..S.

	Job	Team time hr.	Team time min.	Work time hr.	Work time min.
Setting new meters	117	20	39	23	5
Taking off old meters	124	19	21	22	50
Taking off old meters	145	16	46	25	16
Resetting old meters	157	18	6	28	53
Total	543	74	52	100	4

These figures were taken at the time when we were very busy and had a good many meters to take off for repairs and to set, thereby making it possible to route the work very close.

It can be said to show the maximum work that can be done by a horse team under the best conditions, as figures show an average daily setting of 24½ meters per team. Ordinarily when work is normal the average would not be more than 10 to 20 per day.

It will be seen that 42 per cent. of the time was spent in driving the teams to the jobs and back to the shop; 57 per cent. of the time was left to work in.

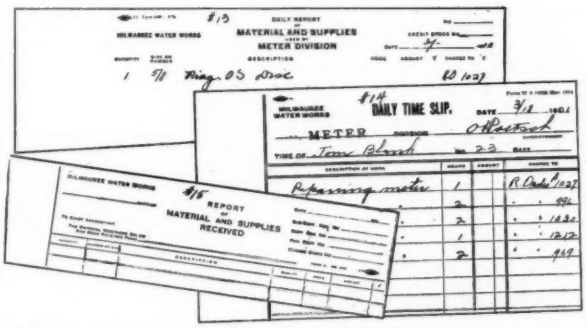
When one realizes that 42 per cent. was spent in teaming under the best condition, one can see that a good percentage of teaming time can be cut down by using a motor truck, thereby increasing the actual working hours considerably, which will result in higher daily average of meters set.

In our case we found that a truck can set or take off thirty-six meters per day.

There is another feature in favor of trucks of great importance. The work can be kept up to the handle at all times.

In using teams, we had the city divided into ten districts, while by using two trucks we were able to cut the city into four districts. The work does not have to wait until it can be closely routed, as was the case when using horses, as the trucks cover a far greater territory.

During the year 1912 we purchased a shaper, pipe-cutting machine, drill press, and wet tool grinder, all equipped with motor drive. These machines, in addition to those that were previously installed, make our machine shop complete. In general, it enables us to do more and better work at less cost to the city, as well as to do more and better work to the consumer. The new shaper has been of great assistance, and work can be turned out on this machine in fifteen to twenty minutes that it formerly took a man several hours to do by hand. Not only does this machine save time, but better work can be turned out. The same is true of the new drill press. The work can be done in less time and more accurately.



FORMS 13—15, *used for recording materials used, time slip, and materials received.*

FORMS 11—12, *repair records.*

Robinson Fire Engine Test

By David M. Hudson, Chief of Fire Department, City of Chelsea, Mass.

Chelsea, Mass., a few months ago tested its newly purchased Robinson piston pump motor fire engine, under the direction of George W. Booth, chief engineer of the National Board of Fire Underwriters. After the incident Engineer Booth addressed a letter to the writer. Following is a complete copy of the letter:

The National Board of Fire Underwriters
135 *William Street.*
New York, May 26, 1913.

David M. Hudson, Chief of Fire Dept.,
Chelsea, Mass.

Dear Sir—Following is a statement of the results of the tests of the Robinson "Monarch" automobile pumping engine recently delivered to your department, made at Chelsea on the 24th inst.:

The first test was made at draft, with a suction lift of 10½ feet, pumping water from an arm of Chelsea creek, thru one line of 100 feet and one line of 50 feet of 2½-inch hose, siamesed into a deluge set with a 2-inch nozzle (actual diameter 2.01 inches). The average discharge pressure during the test was 119½ pounds and the suction lift corresponded to 7½ pounds, giving a net pump pressure of 127 pounds. The average nozzle pressure was 60.8 pounds, corresponding to a discharge of 937 gallons per minute against a net pressure of 127 pounds. The test continued for a period of 45 minutes (except for a delay of 4 minutes to replace a length of burst hose), when it was discontinued in order to make the tests arranged for near the city hall. During the 45-minute test the engine appeared to be running easily, with plenty of reserve power. The tests at city hall were made for short periods, taking suction from a hydrant. Most of them used four 250-foot lengths of 2½-inch hose siamesed into a deluge set of nozzles of different sizes as follows:

With 1½-inch nozzle, discharge pressure 190 pounds, suction pressure 57 pounds, net pump pressure 133 pounds, nozzle pressure 143 pounds, discharge 798 gallons per minute.

With 1⅝-inch nozzle, discharge pressure 170 pounds, suction pressure 50 pounds, net pump pressure 120 pounds, nozzle pressure 124 pounds, discharge 872 gallons per minute.

With 2-inch nozzle, discharge pressure 145 pounds, suction pressure 30 pounds, net pump pressure 115 pounds, nozzle pressure 74 pounds, discharge 1,023 gallons per minute.

Other tests were made with three or four lines of hose, each leading to 1-inch or 1¼-inch nozzle, but I do not feel sure enough of the size of these nozzles nor the nozzle pressures to warrant a statement as to discharge and pressures.

Yours very truly,

(Signed) GEO. W. BOOTH,
Chief Engineer.

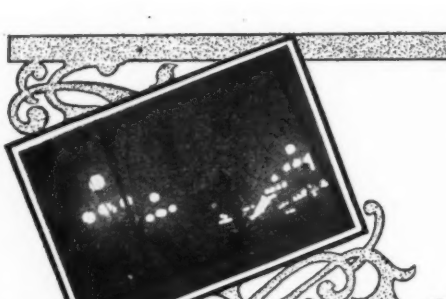
Auto Fire Engine Test

Fire Chief John McFadden, City of Memphis, Tenn., reports that on recent test of auto fire engine, the auto pumps developed a pressure of 220 pounds at the engine and delivered 570 gallons per minute at the nozzle. One stream ⅞ of an inch in diameter was thrown 175 feet in the air at the end of a 250-foot hose, while two streams were thrown 150 feet in the air. The water was pumped from a cistern, without the aid of the pressure from the city mains, and a leaky valve further handicapped the test; however, Chief McFadden was well pleased with the result.

The addition of an automobile engine for suburban service has greatly increased the general efficiency of the department, which is already rated as one of the best in the country. It is estimated that the upkeep of the auto engine is approximately 15 cents a day.

There were 56 fires in Memphis during October, 1913, according to department reports, which resulted in a total estimated damage of only $4,045. This is regarded as truly remarkable and reflects more eloquently than anything else can the efficiency of the department. Fifty of the blazes were confined to the rooms in which they originated. Three were confined to the building in which they originated, and the remaining three to property immediately adjoining.

Tiny electric bulbs, supplied with light from a small storage battery, now make it possible for engineers to read the gages on the darkest nights. As a result the practice of carrying lanterns for this purpose has been discontinued. The little incandescents are located immediately over the gages and the batteries are placed at out-of-the-way places on the engines.



Lighting

Philadelphia Specifications for Alley and Suburban Lighting

For 1913 the city of Philadelphia has a contract with the Welsbach Street Lighting Company of America, for about 20,000 60-candle-power gasoline lamps for lighting alleys and country roads at the rate of $29 per lamp per year.

For 1914 it is proposed to open the bidding to all kinds of light, bids to be received on candle-power specifications made by the bidders themselves. Advertisement was made calling for the receipt of bids on September 4, but there were no bidders. It is probable that bids will be called for again within a short time.

The special points of interest in the specifications are the following:

The contractor will be required to furnish lamps and the lighting and necessary maintenance thereof, and to light, extinguish and clean the same, such light to be used for the illumination of the streets, avenues, boulevards, sidewalks, alleys, wharves, bridges, parks and other public places in the city of Philadelphia; also to furnish and erect new posts and to properly maintain all property which comes within the scope of this contract.

The lamps shall be lighted in accordance with the time table made a part of the specifications, the lamp lighters not to climb the lamp posts except by ladder leaning against the pole.

The number and location of lamps will be determined by the director and may be changed from time to time.

Lamps will be tested photometrically to determine their actual street illuminating power. The lamps shall be of such kind and shall be so maintained that the complete lamp including accessories will give a light of not less than the candlepower stated in the proposal at an angle of 15 degrees below the horizontal, as determined by the tests specified. The light which is furnished on the average as determined by tests on not less than one per cent. of all the lamps each month shall be of not less than the above specified candlepower. The term "candlepower" wherever used in these specifications shall be interpreted as the intensity of the light expressed in terms of the International Candle as maintained by the National Bureau of Standards.

CITY reserves right to make candle-power tests and also specifies by what means they shall be made.

The city shall have the right at any time to test the quality and illuminating power of the lamps as furnished on the street and for that purpose one per cent. or more of the lamps may be selected from those in actual use in each district in each and every calendar month and their illuminating power shall be determined by measurements made as nearly as practicable at the angle of 15 degrees below the horizontal. The measurements shall be made on the lamps as complete units as operated on the street, and shall be made with the lamps in their regular position, by means of a Sharp-Miller portable photometer using a detached test plate and a mirror so mounted as to throw upon the test plate light emitted from the lamp at an angle of approximately 15 degrees below the horizontal. The average results of measurements made on any two opposite sides of a lamp shall be considered the mean candlepower of that lamp, provided that no measurements shall be made in a direction such that the frame of a lamp or a rod carrying a chimney or any similar accessory comes between the source of light and the test plate. The average candlepower of the lamps tested in one month in any district shall be considered as representing the light furnished by all the lamps in that district for that month.

No allowance will be made for light absorbed or obstructed by glass housings or accessories, since the candlepower stated in these specifications is intended to represent the average amount of light actual-

ly delivered on the street, and the object of the tests is to determine whether that amount of light is actually delivered.

The testing shall be made by two men, one representing the city and paid by it, and the other representing the contractor and paid by him. The report of measurements made by these two men shall be made in duplicate and signed by both men, one copy being supplied to the city and the other to the contractor. In case the contractor, after receiving due notice, shall fail to provide a man for the testing, the city may provide a second man and may deduct the expense thereby incurred from any amount otherwise due to the contractor.

The lamps in each district shall be numbered and listed consecutively, and the lamps selected each night for measurement shall be designated by their numbers. In the selection of lamps to be tested, which shall be by lot, the contractor's representative shall have an equal voice with the city's representative, but any disagreement or dispute shall be settled finally by the director.

If any dispute arises as to the methods of testing, apparatus used, or the results obtained, between the two inspectors, or between the city and the contractor, such dispute shall be referred to the National Bureau of Standards for settlement. The cost of such reference shall be paid equally by the city and the contractor.

No lamp showing less than 15 candlepower upon photometric test as described above will be included in the report made to the city and the contractor. The outside of the outer glass globe or housing of the lamp may be rubbed over before the test with a clean dry cloth.

DEDUCTIONS shall be made from contract price for failure to supply average candle power.

If the average candlepower of the lamps tested in any month falls below the minimum average candlepower stated by the bidder, then the contractor shall receive as full payment for that month the proportion of the total amount otherwise due him that the average candlepower obtained in the tests bears to the average candlepower so stated.

The contractor operating and maintaining the lamps tested shall replace lamps on the street not to exceed seventy-five (75) in each district in any one month whenever the director may request such replacement, free of cost to the city, and shall always keep in stock ready for operation at least seventy-five (75) lamps for each district.

The contractor will be required to furnish a patrol system which will be adequate to care for all lamps extinguished during the night. And in order to free the contractor from the expense of maintaining headquarters for such patrol system the city will provide six stations at various points over the city where said patrol may have space for desk, tools and necessary appliances for emergency repairs to the lamps.

All of the lamps are to be kept in a cleanly condition and all parts of the lamps shall be cleaned at least once a week; all the glass of the lanterns shall be thoroughly cleaned, both on the inside and on the outside, and all dust and dirt shall be brushed from the frames.

Any lamp which does not furnish illumination the full time required by the time table or which fails to deliver at least fifty (50) per cent. of the average minimum candlepower required by these specifications will be considered as "out" and the specified liquidated damages therefor will be collected under the conditions specified in a subsequent paragraph. Any lamp reported twice within 36 hours as an "out" shall be replaced by another lamp or by that part of same which constitutes the source of light at the option of the said director.

NEW lamp posts to be installed shall be according to designs and specifications meeting approval of directors.

New lamp posts, of a design satisfactory to the director, blueprints of said designs, giving dimensions and weights, to be submitted with the bid, are to be erected and fitted up on any street, avenue, boulevard, park, alley, wharf or public place wherever the same may be required by him, and are to be placed in a strictly perpendicular position. The butt of the lamp post shall rest on a solid foundation to prevent the same from settling, and the earth shall be thoroughly tamped about the butt, as the same is thrown into the excavation. These posts will become the property of the city as soon as erected.

All posts now in use are owned by the city, and the contractor shall have the use of them during the term of his contract.

If a new contractor shall have a contract for any or all of the lamps included in this contract at its termination the present contractor shall, at the direction of the director, remove such of his property and at such times as the director may order, so that the new contractor may have all of his plant in complete working order by the first day of his contract. The new contractor will receive no compensation for the lights which he may install and operate before the expiration of the present contract in place of lights included

in this present contract, and the old contractor shall receive full compensation for all such lights.

In case any lamp should fail to furnish illumination continuously the contractor will pay the city a sum of money equal to four times the charge to the city for one night's illumination for each lamp, for each and every night or part thereof that such failure shall continue. Provided,; that no lamp shall be considered an "out" until it has twice been reported out in a space of thirty-six (36) hours with an interval of at least three hours between the reports. The first and second reports of such a lamp out are to be made simultaneously to both the company and to the city. This double report is made to insure opportunity to the contractor to relight the lamp which is out and supply the city with the necessary light.

The bidder is to state the candlepower which he can most advantageously furnish, which must not be less than forty-five (45) nor more than sixty (60) candles, measured in a direction of 15 degrees below the horizontal. (A lamp of higher candlepower than 60 will be considered 60.)

CHARACTERISTICS of lamps and accessories which must be set forth in the contractor's bid.

Each bidder must supply with his bid a full statement of the characteristics of the lamp and accessories on which he is to bid including a statement of the iluminating medium to be used. These full characteristics are to include the following:

Distribution curves of the lamp as a complete unit (including reflectors, globes, etc., if any are to be used), and life curve showing how the candlepower in a horizontal direction, or at 15 degrees below the horizontal, decreases with the time of burning.

Complete working drawings of the lamp and all accessories including individual drawings of each part and one drawing of the lamp as a complete unit. Dimensions and weights to be stated on these drawings. Where protection to any patent right would interfere with complete working drawings being furnished, bidders upon so certifying may furnish assembled drawings in lieu thereof.

Statement of operation and performance of the lamps and such records of tests and performance as will be useful in judging the merits of the lamps.

The contractor for 1914 agrees that in case he is not successful in obtaining the contract for 1915 he will continue lighting his lamps after the close of his contract until the new contractor can install his own equipment, which installation must be completed by February 15, 1915. The contractor for 1915 will pay the present contractor for all service which he, the present contractor, supplies subsequent to January 1, 1915, the amount per lamp per night which the latter receives, unless the amount received by the new contractor for 1915 shall be less than is paid for 1914, in which case the price to be paid will be that fixed by the new contract.

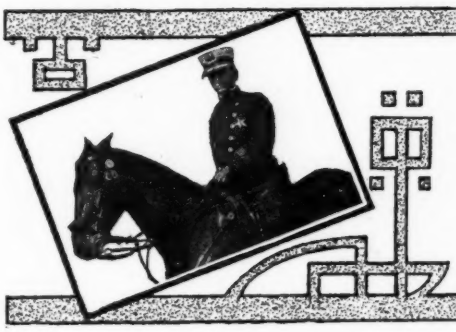
The time schedule provides for 3,955 hours of light per lamp for the year.

The city is divided into three districts having 7,911, 7,934 and 3,278 lamps respectively, the total number of lamps to be included in the three independent bids being 19,117.

Gas Rates in Large Cities

To the list of artificial gas rates in large cities given in the July number may be added the following compiled by the Citizens Gas Company, of Indianapolis, Ind., to show what the 60-cent rate charged by both the companies is saving the consumers at the same time that the company named is paying 7 per cent. dividends on its stock:

City.	Gas per 1,000 Ft.
Albany, N. Y.	$1.00
Baltimore. Md.	.80
Boston, Mass.	.80
Bridgeport, Conn.	1.00
Buffalo, N. Y.	1.00
Cambridge, Mass.	.80
Chicago, Ill.	.80
Cleveland, O.	.80
Dayton, O.	.85
Detroit, Mich	.75
Grand Rapids, Mich.	.80
Jersey City, N. J.	1.00
Lowell, Mass.	.85
Milwaukee, Wis.	.75
Minneapolis, Minn.	.85
Montreal, Can.	.95
Nashville, Tenn.	1.00
Newark, N. J.	1.00
New Haven, Conn.	.90
New York, N. Y.	.80
Ottawa, Can.	1.00
Philadelphia, Pa.	1.00
Pittsburg, Pa.	1.00
Portland, Ore.	.90
Providence, R. I.	.85
Rochester, N. Y.	.95
St. Louis, Mo.	.80
San Francisco, Cal.	.80
Seattle, Wash.	1.00
Spokane, Wash.	1.50
Syracuse, N. Y.	.95
Toledo, O.	.70
Toronto, Can.	.70
Winnipeg, Can.	1.20



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

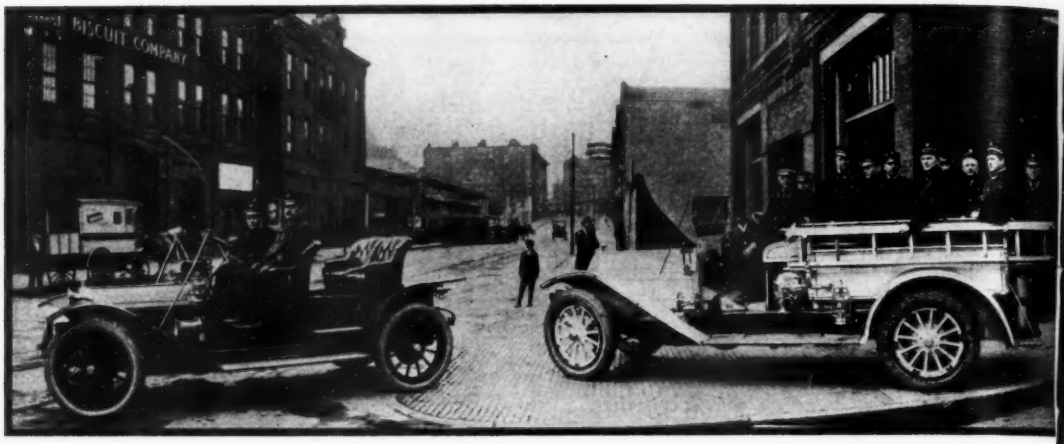
Street Reconstruction and Repair—Whether work to be done on a city pavement is reconstruction, or merely a repair thereof, depends on the character and extent of the work itself, and not on what it is called in the proceedings taken therefor. Where there is a dispute as to the nature, character and extent of the work to be done in improving the pavement of a street, the question whether the work done is reconstruction or merely a repair of the pavement is for the jury, under proper instructions defining what constitutes each.—Parker-Washington Co. v. Meriwether et al., (Mo.) 158 S. W. 74.

Eminent Domain—Damaging Property by Public Improvement—Compensation—Defendant levee district, having been organized pursuant to Rev. Civ. St. 1911, tit. 47, proceeded to construct a levee near the city of Fort Worth adjacent to a point on the Trinity river, where the city maintained a pumping plant. It appeared that during the highest flood the pumping stations had not been seriously flooded, but that with the construction of the levee the plant in ordinary flood times would be submerged approximately five feet, and that by reason thereof the machinery would be damaged and the city and its inhabitants deprived of a water supply. Held, that such injury amounted to a direct invasion of the city's property so as to destroy it for its accustomed use, constituting an actual appropriation thereof, and hence the city was entitled to an injunction restraining the completion of the work until compensation had been provided and paid, according to Const. art. I, sec. 17, prohibiting the taking or damaging of any person's property for public use without providing compensation.—Fort Worth Imp. Dist. No. 1 v City of Fort Worth, (Tex.) 158 S. W. 164.

Municipality Liable for Sewer Constructed Under Void Contract but Afterwards Utilized Legally—Where a contract for the construction for a village of a sewer system was invalid for non-compliance by the village with the general village law, but the village thereafter took proper proceedings under the law for the construction of a system and appropriated and utilized the work done and materials furnished by the contractor, it was liable to the contractor for the work done under the contract.—Ward et al. v. Kropf, Pres. of Waterloo, (N. Y.) 101 N. E.469.

Franchise Construed in Favor of Public—City May Construct Plant—Appraisement not Notice of Purchase—A grant of a franchise or privilege is to be strictly construed in favor of the public. Whatever is not unequivocally granted is withheld, and nothing passes by implication. A provision, in an ordinance granting a franchise to a water company and contracting for hydrants, that during the term of the grant the city would not "contract with any other person or persons, corporation or corporations, for a supply of water," does not preclude the city from constructing a water system of its own during the term. Where an ordinance granting a franchise to a water company gave the city an option to purchase its plant at a value to be fixed by appraisers, and provided that in case the city decided to purchase it should serve notice of such determination 6 months prior to the time the purchase was to be made, but did not specify whether such notice should be given before or after appraisal, a mere request by the city for the appointment of appraisers did not bind it as an election to purchase, after the appraisers had failed to agree. Washington-Oregon Corp. et al. v. City of Chehalis, et al. 202 Fed. 591.

Streets—Liability for Injuries—A city constructing and maintaining an inadequate water intake in the improved part of a street at an intersection where pedestrians had a right to cross, and allowing it to be concealed by weeds, so that, after an erosion around it, it became a trap, was liable to a pedestrian injured thereby. Twedell v. City of St. Joseph (Mo.) 152 S. W. R. 432.



FIRE DEPARTMENT *squad of St. Paul, Minn., including*

MOTOR DRIVEN

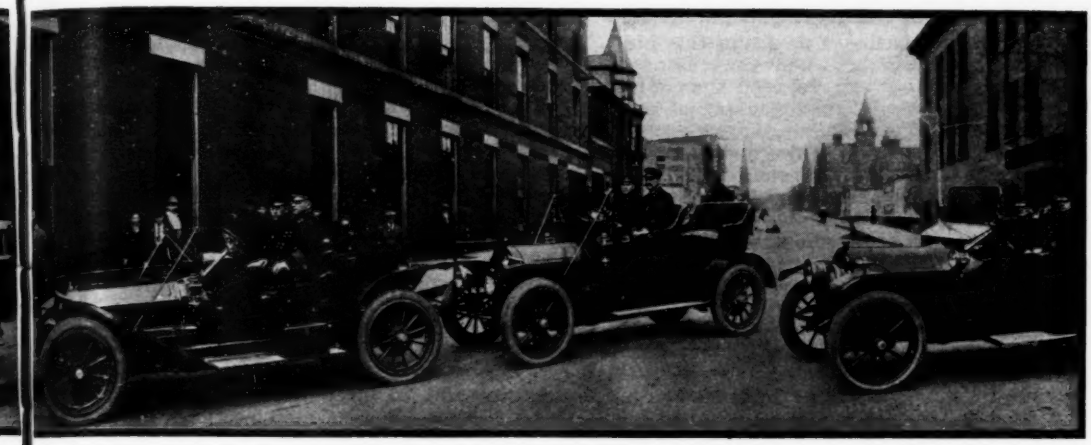
WITH a view toward promoting higher efficiency among the hundreds of fire departments throughout the United States, MUNICIPAL ENGINEERING *inaugurated a contest two months ago which has resulted in the gathering of valuable information on the subject "Care of Motor Driven Fire Apparatus."*

A series of cash prizes were offered as an incentive to command the attention and interest of leading fire department authorities throughout the country. As a result a great number of valuable articles were submitted for the consideration of the editors. The editors selected a committee of five disinterested parties, familiar with the subject of motor fire apparatus, to whom the articles were submitted. Their award of cash prizes is as follows: 1st J. M. Taylor, Springfield, Mass.; 2nd F. H. Bemis, St. Paul, Minn.; 3rd P. J. Reddy, Capt., Cleveland, Ohio; 4th D. J. McCue, North Braddock, Pa.; 5th O. B. Mercer, Chief F. D. Westville, Conn.; 6th R. F. Turner, Jacksonville, Fla.

From month to month these articles and some of the others submitted will be published.

When this contest was started it was with the distinct understanding that it was not to be a literary competition, and that articles would be judged solely on the merits of the facts presented. Our readers are therefore presented with facts, which in some cases are a little homely in wording and phraseology, but that are nevertheless from men who are best qualified to judge of what is necessary to secure efficiency.

One of the qualifications of this contest was that none would be allowed to enter except those actually connected in an official capacity, or as an



the chief, his lieutenants and the emergency squad machine.

FIRE APPARATUS

employe, in a fire department. The publishers solicit criticisms and suggestions on the articles presented. If there are others who consider that they have in operation more efficient methods than those described, we should b very glad to receive articles from them.

This is the first contest, to our knowledge, which brings to a focus the experience of fire department officials on the proper care of motor driven apparatus. The articles themselves and the discussions which will undoubtedly follow will be of great value to those who have adopted or are contemplating the adoption of this comparatively new method of protection of property. *THE EDITORS.*

Care of Motor Fire Apparatus

By F. H. Bemis, St. Paul, Minn.

The motor is the first consideration in motor-driven fire apparatus, and the fuel is one of the very important elements in its operation. As good coal is essential to raising steam pressure in a boiler rapidly, so are good gasoline and lubricating oil necessary in making quick starts with a gas engine. To use either poor coal or gasoline is false economy where time and efficient operation are so absolutely necessary.

All gasoline engines use a carbureter, or vaporizer of some kind, to mix the gasoline with air, the correct proportion being about fifteen parts of air to one of gasoline for the best explosive mixture. The gasoline is regulated by a needle valve on most makes of carbureters and the air by numerous kinds of valves or ports, one air port must be always open. In addition there must be an auxiliary air valve which begins to open as the motor gains in speed. This must always be tightly closed when starting the motor, as any extra amount of air will cause difficult starting. There are also several devices

on the market for increasing the air supply from the dash. A device of this kind is very useful, for when the engine is warm more air can be used than when cold, which results in the saving of gasoline.

For ease in starting the motor, the operator should have a means of closing or partially closing the air intake to the carbureter, also a priming valve, such as a pump to draw gasoline from the supply tank and thence force it into the intake manifold. Care must be used not to flood or overdose the engine with gasoline, as this will make trouble instead of giving assistance. Two tablespoonsful are sufficient for any motor under 100-h.p. Good compression is essential to easy starting.

A gasoline strainer is very important. One should be placed on the end of the pipe leading into the tank and extend a couple of inches inside of it; one also on the end near the carbureter. This will hold back most of the dirt which somehow or other finds its way into a tank. It is best to strain galosine thru a chamois skin. Also a water trap should be placed between the carbureter and the tank, to catch any water which might be in the tank. Water is sure to accumulate from condensation or sweating and will give rise to trouble if it reaches the carbureter.

PROTECTION of air ports important in preventing the clogging of the carburetor and also fires caused by back-firing of motor.

All intake air ports should be protected from dirt with a screen of fine mesh, as any dirt or other substance, such as waste or bugs, will be drawn into the carbureter and possibly cause trouble. Another advantage is the prevention of fire. Nine out of ten auto engines and machines catch fire from a premature explosion; i. e., the gas is ignited in the cylinder before the intake valve has closed, thus allowing the flame to pass back into the carbureter and ignite the gasoline which remains in the air inlet pipe. If this pipe or port is covered with the wire gauze, the flame will be stopped by the gauze.

Cold weather necessitates a water jacket around the carbureter, which, if possible, should extend part way up the manifold, the jacket to have a pipe leading in and one out in connection with the water circulation of the engine, with means for adjusting the flow thru the jacket. This will cause the gasoline to vaporize more easily and prevent freezing or frosting of the carbureter in zero weather. Also the air intake should lead to the exhaust pipe, not touching, but close enough so that the heat from the exhaust pipe will be drawn thru it into the carbureter.

The double system of ignition is preferable; that is, two independent sets of spark plugs, one taking current from a battery and the other from the magneto, with a switch arrangement allowing the motor to run on one set alone or both together. This insures a spark in all cylinders as far as the plugs are concerned, and when water is wanted or an alarm comes in there is no time to change a plug, and it is a rare thing for both plugs in any one cylinder to get out of order at the same time. Also using two spark plugs in a cylinder gives a slight increase in power. The space between the points of spark plugs is important. I find that for hard service the battery plugs should have a space of 1/16 of an inch; for the magneto, 1/32 is enough. A plug with four sparking points is best for the magneto plugs. All plugs should be protected from water, in order to prevent cracking of the porcelains.

LUBRICATING oil should be drained every two hundred and fifty miles, and kerosene run in the motor to cut carbon and old oil.

When the lubricating oil becomes dirty or black, as in running 250 miles, or after a long period of pump operation, the oil should be drained from the engine, and kerosene used to clean out the pipes and crank case. All kerosene should be removed before adding fresh oil. It is also good practice to flush the engine (while the motor is running) with kerosene. This is best accomplished by dribbling and tapping the intake manifold to take a small pet cock; a rubber tube can be pushed over the end of this; then drop the free end in a quart of kerosene; the suction of the pistons will draw the liquid into the cylinders, care being used not to stall or stop the motor; the flow can be regulated from the pet cock. The kerosene will loosen and soften any carbon that may be on the valves or in the cylinder; it will also cut any of the dirty or gummy oil from the piston rings or spark plugs. After using the kerosene in this manner, the motor will speak for itself by running smoother and starting better. The pet cock must be kept closed when not in use. The last word on the engine is, keep it clean and well oiled.

On motor-driven apparatus a bell is practically useless, for the reason that the sound of a bell will not carry far enough to give sufficient warning of the approach of fast-moving fire apparatus, and the apparatus may be mistaken for a street car or ambulance. I am speaking from personal experience of five years' driving of motor apparatus. The best warning is the siren horn. One of these horns has a sound all its own, and if used exclusively by fire apparatus the traffic

knows what is coming, and the horn can be heard a mile, giving anything time to get out of the way. If the flexible shaft drive is used, the horn should be placed in as straight a line as possible with the driving pulley and kept well oiled, and the couplings should be looked over often to see that they are tight, as without the horn working the efficiency of the machine is cut in half.

The main point in the care and maintenance of any motor fire apparatus is to have an experienced man behind the wheel.

The brakes need considerable attention and should be adjusted evenly. When the brake pedal is applied it is essential that one exert the same pressure as the other. If one brake band holds better than the other, a machine is very much more apt to skid than if they both grip with the same pressure. Also more time is consumed in coming to a stop. To adjust the brakes evenly, jack up both rear or driving wheels, first blocking the front or steering wheels; see that the brakes are not holding with pedal released. Then start the motor and put the gear lever in second speed, allowing the wheels to spin. Now apply the brake, taking notice which wheel stops first. If one stops sooner than the other, very little taking-up of the other will cause them both to stop at the same time. The brake drums must be kept free of all grease or oil and should be looked over after every run. Grease on the brake drums has caused many accidents.

IN THIS instance electric lighting has proved the most satisfactory.

For lighting purposes the best, in my experience, is to have an electric generator driven by silent chain belt from the water pump shaft or magneto shaft. For lights and ignition, 6 volts, 10 amperes are large enough to keep a 100-ampere-hour battery supplied with current to light headlights, taillights and inspection lamps. The generator should have an automatic cut-out to prevent burning out or overcharging the battery. A system, such as described, has given perfect satisfaction at all times for the last five years, and is still in use. Once a year the battery must be washed out and new electrolite added, and while in use should not be allowed to run dry; the plates should be kept covered, and only distilled water should be used.

Skid chains are necessary on the tires which do the driving, when there are wet streets, loose sand or snow to run over. The chains should never be adjusted very tight, nor should springs be used to draw them tight to prevent rattle. Let them rattle a little, and the tire will wear longer, for if the chain remains in one place there will be excessive wear on the tire at that point. The chain should be as tight as it can be drawn with the hands. For chiefs' autos or the squad wagons a chain on the left front wheel is advisable to prevent a front skid when turning corners in snow or mud. The only thing possible to do when the front starts to skid is to stop if you can.

For motor-driven apparatus the following places should be provided with grease cups of ample capacity: All spring shackles and end joints; steering gear box, and all friction joints of steering gear; on the pump used for water circulation; on both bearings of the siren horn; and all friction joints on the rear axle construction. Small oil cups are more trouble than use, as they will clog in spite of any care they receive. Good force grease cups are sure and cleaner in every way.

KINDS of tires to use for cars of different weights.

For cars weighing up to five tons, loaded, pneumatic tires are the best, as they ride the easiest with consequent saving to the machinery. Over three tons, the apparatus should have dual tires on rear, all inner tubes to be of extra thickness nearest the tread. There are inner tubes on the market which have tapering walls from one-eighth of an inch at the bottom to five-eighths at the top. With a tube of this kind the outer casing can be worn almost thru without danger of a blow-out or puncture. Also while the car is standing, better support is given the outer casing. The tires should be kept free from oil, as it will soften the rubber, making it spongy. They should be kept well inflated always, as a tire will wear out quicker from being run soft than from any other cause. Do not lower the pressure in hot weather, as any expansion from heat will not injure the tire on the short runs which fire apparatus has. All cuts in the casing should be repaired at once, as dirt and water will work thru and destroy the fabric, causing a tire blister, which will ruin a tire in short order.

Nickel trimming should be used whenever possible, as it is the easiest to keep clean and always looks neat and stays clean the longest.

International Association of Fire Engineers

The forty-first convention of the International Association of Fire Engineers, beginning September 1, had the difficulties regarding regularity of attendance

which seems to be inherent in conventions held in New York and other large cities, but accomplished marked results particularly in the discussion and elucidation of the questions of motor apparatus, fire prevention and incendiarism.

Among the valuable papers on motor apparatus were those on "British Motor Fire Engines," by Arthur R. Dryer, delegate from the fire brigade of London, England; "Durability, Efficiency and Economy of Motor Fire Apparatus," by Chief A. V. Bennett, Birmingham, Ala.; "Defects and Cost of Maintenance of the Motor Pumping Engine," by Chas. S. Demarest, chief of construction of New York fire department.

A twelve-hour test of motor pumping engines was made on Wednesday, September 3, in which there were eleven entries. It demonstrated the efficiency and reliability of the motor apparatus. The entries, with their capacities in gallons per minute, were as follows: 1, Seagrave, 1,000 gal.; 2, Ahrens-Fox, 700; 3, American-LaFrance, 700; 4, Luitweiler, 600; 5, American-LaFrance, 1,400; 6, Knox, 600; 7, Nott, 600; 8, Robinson Jumbo, 750; 9, Nott, 800; 10. Robinson Monarch, 900; 11, Waterous, 700 gal. Nos. 1, 2, 5, 6, 8, 9, and 11 were still in operation at the end of the test and the log showed that Nos. 1, 2, and 11 lost no time during the test, tho No. 1 required 20 minutes to get water at the start on account of a leaky suction joint.

No. 4 dropped out of the test in the ninth hour on account of hot bearings; No. 7 in the ninth hour on account of leaky cylinder gasket letting water in; No. 10 in the tenth hour on account of leaky pump valves; No. 3 in the eleventh hour on account of fire pump bearing, followed by motor trouble after bearing was repaired. All engines started with large nozzles, 1¾ to 2¼ inches, and pump pressures of 120 to 130 pounds, showing slightly above or below their rated capacities with the nozzles and pressures used, except No. 4, which was 103 gallons below its rated capacity. From time to time the nozzles were changed for progressively smaller sizes, those finishing the tests having 1 to 1⅝-inch nozzles in use at that time with pump pressures of 192 to 296 pounds. The troubles requiring stoppage were nearly all pump and bearing troubles and the few engine troubles developed, with the exception above noted, did not cause stoppage, being adjustable while running.

The exposition of fire apparatus and supplies also demonstrated the advance in motor fire apparatus, practically all the apparatus exhibited being of this type. Among the exhibitors of fire apparatus were the Knox Automobile Co., of Springfield, Mass.; the American LaFrance Fire Engine Co., of Elmira, N. Y.; the Seagrave Company, of Columbus, O.; the Ahrens-Fox Engine Co., of Cincinnati, O.; the Nott Fire Engine Co., of Minneapolis, Minn.; the Waterous Engine Works Co., of St. Paul, Minn.; Pope-Hartford Co., of Hartford, Conn.; James Boyd and Brothers, of Philadelphia, Pa.; the Robinson Fire Apparatus Mfg. Co., of St. Louis, Mo.; the International Motor Co., of Rochester, N. Y.; the Martin Carriage Works, of York, Pa.; the White Company, of Cleveland, O.; Peter Pirsch & Co., of Kenosha, Wis., by photographs. Tractors for use with fire apparatus were shown by the Martin Tractor Co., of Springfield, Mass.; the American and British Mfg. Co., of Providence, R. I., and Christie Front Drive Co.

The discussion of fire insurance, incendiarism," by oJseph Johnson, fire comall sides of these questions. There were many valuable papers, such as those on "Fire Insurance and Its Relation to Incendiarism," by Joseph Jefferson, fire commissioner of New York, and Frank Lock, New York manager of the Atlas Insurance Co. of London; "The Relation of Incendiarism to the Fire Loss," by John Kenlon, chief of New York fire department; the discussion by F. M. Griswold, of the National Fire Protection Association; "Inspection of Buildings and Contents by Uniformed Members of Fire Departments," by H. C. Bunker, chief of fire department, and D. F. Cash, director of safety, of Cincinnati, O.; "Fire Prevention and Uniform State Fire Marshal Laws," by Eugene D. Stocker, deputy state fire marshal of New York; "Fire Prevention and Fire Protection," by tSate Fire Marshal Thos. J. Ahearn, Albany, N. Y.

The officers elected were: Thomas W. Haney, Jacksonville, Fla., president; Hugo R. Delp, Lansing, Mich., and Harry L. Marston, Brockton, Mass., vice presidents; James McFall, Roanoke, Va., secretary; George Knofflock, Mansfield, O., treasurer. New Orleans, La., was chosen as the next place of meeting.

Maintenance of Tractor Motor.

By P. J. Reddy, Captain of Hook and Ladder Company No. 1, Cleveland, Ohio.

The largest piece of fire apparatus in use is operated by Hook and Ladder Company No. 1, of Cleveland, O., of which P. J. Reddy is captain.

The machine is described by L. A. Quayle, assistant engineer of the division of power, and the method of maintenance and operation of the motor is given by Captain Reddy in an article which received the third prize for articles concerning maintenance of fire department motors.

The following outline will give an idea of the system of maintenance followed:

One man is placed in charge of the motor. However, it is necessary to have at least four men capable of operating the machine, on account of days off, meal hours, and leaves of absence. When No. 1 is on duty he takes charge and cares for the motor; when he is off duty, then No. 2 takes his place, and so on with No. 3 and 4, there being one man always responsible. These men are interested in motor apparatus and are men of good judgment. We have drivers who have never operated an automobile prior to being instructed on this apparatus, and they have proved to be excellent.

The care of motor apparatus involves several important functions which are, in the main, proper management, caution and economy.

Now, where, when and how shall these be accomplished? In all fire departments there are three places, namely: In quarters, on the road, and at fires, each to be considered and governed separately.

Answering the first, at quarters, after returning from a fire or a run, the motor must be gone over systematically and carefully. No matter what the hour of the day or night may be it must be ascertained that every part is in perfect order for the next run. A hurried inspection will not do, with the idea in mind that anything that may be wrong can be repaired or adjusted the next day. A nut or bolt might be loose and for the want of immediate attention it may work out and disable the motor before the next run has been completed.

A periodic inspection must be given the ignition wiring, ascertaining that it is in perfect condition. Inspect the batteries, see that there is the proper amount of water (distilled) above the plates; see that the dry cells test out to their proper voltage; see that vibrators are not pitted and sticking; see that the coil box is kept dry from rain or other wetting; see that the spark plugs are not broken or set too far apart. The magneto must be kept clean, dry and covered with leather boot. The oiler must be inspected regularly, this being a particular part. Have the oiler properly adjusted, have plenty of oil, see that none of the oil pipes are clogged with bits of waste, or other dirt; see that the valves are properly set and the engine properly timed. The carbureter must be adjusted for weather conditions, giving a richer mixture in colder weather than in warm. Have all bolts tightened after every run, keep the brakes properly adjusted; see that the drive chains are kept clean and free from dirt, lubricating them with graphite mixed with oil; keep the grease cups well filled and turn them down at least once a week; keep the engine clean and properly oiled; see that the lamps are in good working order for night service.

Have your spark and throttle set at proper place for immediate use. Do not allow them to be moved after they have been set. It is very important that they be ready at all times for the immediate starting of the motor.

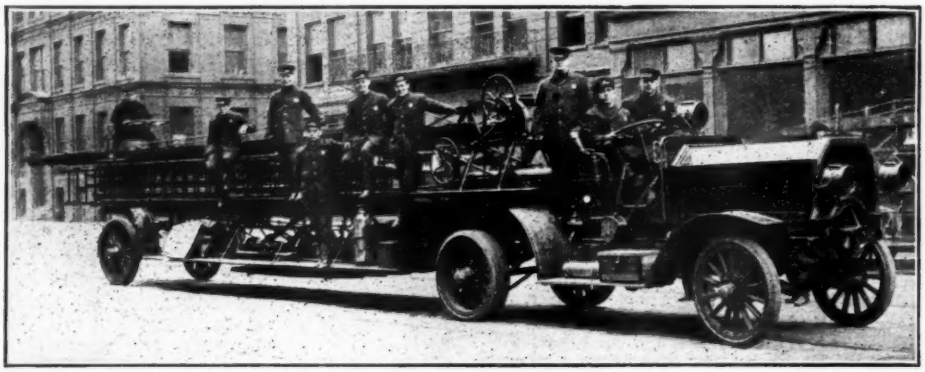
Remember to have the gear shift levers in neutral and do not have the emergency brake set in quarters. At least every two months the wheel bearings should be inspected and greased if necessary. Be careful to keep the tires free from oil, as lubricants rot rubber quickly and cause the outer casing of rubber to separate from the fabric.

After periodic and proper attention has been given to the ignition, timing gears, valves, cylinders, bearings, engine, bear box, brakes, batteries, clutch, springs, greasing, oiling and all other accessories, we come to the consideration of what is necessary in answering an alarm.

When starting out to a fire, start on the battery, then be sure to switch over to the magneto. Advance the spark to its highest point or where it gives the best service. In changing gears do not attempt to force them into mesh, as a great many gears are stripped by constant forcing, a habit which is easily acquired in the anxiety to get under way quickly. When changing gears do not let the clutch in too quickly, but gradually, with the motor getting enough gas to keep the apparatus under the headway secured at the various gear speeds. The apparatus should have sufficient headway to admit of the change to second without imposing any more effort or strain on the motor than it was subjected to in the first speed. When

changing from a second to third the apparatus should be going at a speed of about 5 miles per hour. When changing to fourth the speed should be about 10 miles per hour and the machine should always be on a straight road before the gears are changed.

When approaching a corner or vehicles, precaution should be taken by disengaging the clutch and applying brakes lightly, so as to be under control in case of some unforeseen danger. By observing the precautions mentioned it will usually not be necessary to use the emergency brakes. Their continual application on a grade, different surface condition, etc., the foregoing is the procedure we follow and by which we have obtained the best results. In reversing the apparatus be careful to completely mesh the gears and do not force them into place. Constant forcing sooner or later chips the edges of the gears, which reduces their surface of contact and ultimately causes them to strip. We have known of cases where large pieces have been stripped off, and have caught between the gears, with the result that on the following revolution shafts have been sprung and bearings thrown out of alignment.



SEAGRAVE *tractor which has motorized a large hook and ladder. This apparatus is one of the largest of its kind in use.*

heavy fire apparatus is bound to subject the tires to wear as well as the apparatus. Great care should be taken in judging distances, as in passing of street cars or vehicles which may be standing on streets.

When passing cross-overs, railroad tracks, holes, bumps, etc., the engine should be slowed down in order to lessen vibration as much as possible. A great many breaks occur by failing to observe this precaution. Upon approaching railroad crossing sufficient power should be available to pull the apparatus over with safety. The safest method to follow when handling heavy apparatus is to approach such difficult situation on a higher gear than to drop to a lower. The delay due to stalling and starting the motor again may often be sufficient to result in a serious accident.

When going down a hill disengage engine and apply emergency brakes enough to be in safety and foot brakes if necessary—it being best to be always in gear. In coming up hill keep in low gear and retard spark to the most advantageous point, and allow enough of the throttle to be open so as not to stall engine. The best methods of making hill runs are difficult to explain as each hill has a different

We now come to the third consideration, the care of apparatus at fires.

When arriving at fires where motor may get wet, either by rain, or by water from the hose lines, and in winter by snow, there should be a canvas carried, large enough to cover the entire machine. The emergency brakes should be set, gear shift levers placed in neutral, the magneto and switch turned off. Also have throttle and spark shut off and at night place red lanterns on outside, both front and rear.

In freezing weather turn the engine over frequently where there is a long stand at fires. Before returning from fires to quarters inspect the apparatus to see that chains, brakes, etc., are in proper order.

By carefully following this routine the motor apparatus will always be in condition for efficient service. Constant attention to details is essential. The men who are responsible for the care of the machines must be held to rigid observance of their duties. Neglect of one little thing leads ultimately to the overlooking of more important matters, and inasmuch as automobile apparatus performs one of the most important functions to which motors have yet been adapted it is of the

very highest importance that an apparatus of this type be always kept as near 100 per cent. efficiency as is possible for human intelligence to attain. Otherwise losses of great seriousness will occur.

Comparative Operating Cost of Seagrave Tractor and Horses

By L. A. Quayle, Asst. Engineer, Division of Power, Cleveland, Ohio.

Whenever the opportunity occurs, Cleveland's director of public safety, Mr. Charles W. Stage, is supplanting the slow and expensive horse with the speedier and more effective motor or tractor. That this policy increases the efficiency of the fire department and decreases very materially its operating cost, is clearly shown by the following carefully compiled data.

Located within one-quarter of a mile of the public square and from one to three blocks from the long steep hills leading down to the flats along the Cuyahoga river, where the large lumber yards and factories of all descriptions require constant protection, Hook and Ladder Company No. 1 renders the severest service which firemen and fire-fighting apparatus are called upon to perform.

DESCRIPTION of one of the largest motor-driven hook and ladder equipments in present use.

The hook and ladder truck shown in the illustration is equipped with 345 feet of ladders, 840 feet of life lines, a powerful search light, a pulmotor, an oxygen helmet, life nets, etc., and with its complement of 15 men weighs approximately 8 tons. Formerly three horses were used to pull this truck on level ground, and five were required to haul it up the hills which lead from the flats.

The 90-h.p. Seagrave tractor shown in the illustration has drawn the ladder truck to 215 fires in its six months of service without a moment's trouble in spite of the fact that 80 of these calls were down on the flats, and many times the tractor had to pull up the long steep hills when they were covered with snow and ice. The wheels are 40 by 6 inches, rear wheels dual tires, wheel base of tractor 142 inches, distance between rear wheels of tractor and rear wheels of truck 29 feet 5 inches. The weight of the tractor is 5.1 tons.

After each of these runs the truck was back in the engine house and ready for another call from 15 to 20 minutes before the horse-drawn fire engine returned.

The Seagrave tractor is equipped with a 7¼ by 7¾ four-cylinder engine. A fan mounted on the engine shaft furnishes a blast of air which is conducted thru jackets surrounding the cylinders, and cools them very satisfactorily. A magneto, storage battery, and dry battery are kept in readiness to furnish current to two sets of spark plugs. This tractor ladder truck is 63 feet in length overall, which gives it the distinction of being the longest piece of motor-driven apparatus in existence. The speed of 28 miles per hour which was recently attained on a level road is little short of remarkable when it is considered that the combined weight of the tractor and truck is approximately 13 tons.

COST of operating apparatus with tractor as compared to horses.

The item next in importance to its absolute reliable and efficient service is the tractor's cost of operation compared with the horses it displaced. Altho but three horses were used for pulling the ladder truck on level ground, on account of the severit yof the service, four horses were kept for use on the truck in order to insure the readiness of at least three at all times. The team used for helping the three horses pull up the hills from the flats was used for delivering general supples to several of the fire stations, and no charge is made against the horse-drawn truck for their use.

The average life in service of a Cleveland fire department horse is very nearly eight years but should be five years or less for most efficient service. The last six horses purchased by the fire department cost $300.00 each, which is a comparatively low price. The average cost of keeping fire department horses including feed, harness repair, shoes and veterinary attention, fluctuates between $20.00 and $25.00 per month, and averages approximately $23.00.

The Seagrave tractor cost $4,000 and its life under present conditions of use is conservatively estimated at 12 years. In its six months of service it has traveled 310 miles and consumed 105 gallons of gasoline and 22 gallons of lubricating oil. Altho it has already been found necessary on account of the excessive wear, to replace with larger tires those furnished with the tractor, this change is costing the fire department nothing, as the tires are guaranteed for three years by the makers. Summarizing the above data we have:

Capital Expense for Horses.

Four horses, at $300 each	$1,200.00
Three sections of harness, at $60 per section	180.00
Total capital expense	$1,380.00

Yearly Fixed Charges and Operating Expense.

Interest at 4 per cent. and depreciation at 12½ per cent. on $1,280	$ 227.70
Feed, harness repair, shoeing, etc. at $23 per month	1,104.00
Total yearly expense	$1,331.70

Tractor Fixed Charges and Operating Expense.

Interest at 4 per cent. and depreciation at 9 per cent. on $4,000	$ 520.00
Gasoline, 210 gal., at 16½c	34.65
Lubricating oil, 44 gals., at 30c	13.20
Repairs and miscellaneous supplies	5.00
Total yearly expense	$572.85
Total yearly expense of horse-drawn truck	$1,331.70
Total yearly expense of tractor	572.85
Total yearly saving by tractor	$ 758.85

The saving shown above will be cut down considerably by tire and repair expense after the tractor has been in use a few years, but in any case the saving of the tractor over horses should be considerable. We, therefore, believe we are justified in concluding from the above data that this tractor is just as reliable, much speedier, requires much less attention, and shows a very desirable saving in expense over the horses it displaced.

A Motor Road Sweeper of English Design

The accompanying illustration shows an English Lacre motor road sweeper recently put into operation by the Glasgow Corporation. The six-ton gasoline truck used is one employed for mail, fire, ambulance and street sprinklers. This motor sweeper is fitted with an 18-h.p. 2-cylinder engine, and the speed change gear provides three speeds forward and one reverse.

The speed of this vehicle when not engaged in sweeping operations is 4, 8 and 13 miles per hour, but when the brush is working the best speed of the machine for sweeping is about 7 miles per hour, this being done on the second speed. For light surface sweeping, on moist roads, 10 to 12 miles per hour can easily be obtained.

The diameter of the brush is 18 inches and the length, 5 feet. The power to the road brush is transmitted thru the sprocket shaft by means of a dog clutch engaging with the sprocket wheel, and is operated by a lever situated on the left-hand side of the driver's seat in a very accessible position. The brush is raised and lowered by means of a lever, also situated on the left-hand side of the driver's seat, and is controlled by an adjustable balance weight situated on the offside of the vehicle.

Adjusting brackets on both sides of the brush shaft allow for adjustment and for equal wearing of the brush.

MOTOR ROAD SWEEPER *of English Design.*

MISCELLANEOUS

Wilmington Convention of American Society of Municipal Improvements

The twentieth convention of the American Society of Municipal Improvements to be held at Wilmington, Del., promises to equal its predecessors in interest and value.

Prior to the convention the committees on standard specifications and standard forms will meet with their sub-committees to discuss the reports to be presented to the convention. The first of these sessions will be held at 10:30 Monday morning, October 6, at the Hotel du Pont, Wilmington. Several new sets of specifications will be presented and all persons interested in them are invited to be present and join in the discussions.

The first session of the convention proper will be held on Tuesday morning at 11 o'clock. In addition to the excellent committee reports usually received, the following papers are announced:

On Tuesday: "Separate and Combined sewers in their Relations to the Disposal of Sewage," by John H. Gregory, consulting engineer, New York; "Springfield Sewage Disposal Plant and Its Departure from Common Practice," by Alexander Potter, consulting engineer, New York; "What Obligation, If Any, Is the State Under to a Municipality Where the State Board of Health Has Required the Abandonment of the Disposal of Sewage Into Running Streams," by Chester G. Wigley, engineer for New Jersey State Board of Health; "Some Observations on Minimum Illumination for Street Lighting," by Jos. E. Putnam, assistant city engineer, Rochester, N. Y.; "Education in Fire Prevention," by F. W. Fitzpatrick, consulting architect, Washington, D. C.; "Fire Prevention," by Powell Evans, Department of Public Safety, Philadelphia, Pa.

On Wednesday: "Proposed Standard Specifications for Paving Brick of the American Society for Testing Materials," by Prof. Edward Orton, State University, Columbus, O.; Reports of committees and sub-committees on standard specifications and standard forms.

On Thursday: "The Standard Abrasion Test for Paving Brick, How it Works in Newark," by W. A. Howell, Newark, N. J.; "Making Street Embankment by Rolling vs. Natural Settlement," by Geo. C. Warren, Boston, Mass.; "Control of Sidewalk Construction and Maintenance," by A. Prescott Folwell, New York; the query session is set for Thursday morning.

There will be a boat trip on Wednesday afternoon and visits to city departments on Friday. A. P. Folwell, secretary, 50 Union Square, New York City.

William J. Gaynor

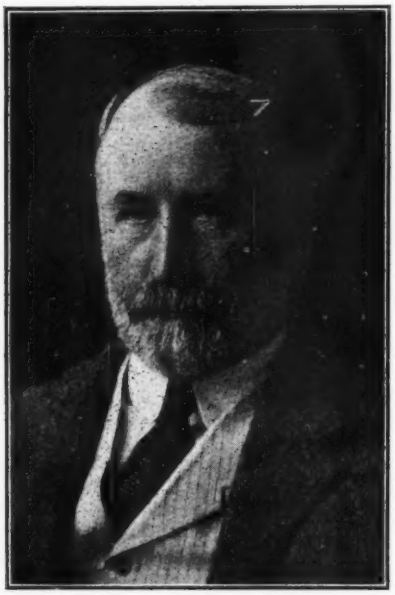
The mayor who, in all probability, has done the most for the people of New York City, has dropped out in the way which every live and growing man would prefer, in the full tide of activity and at the height of his progress. He was but sixty-two years old but in the past thirty years has done more in removing bad political conditions and instituting new and better methods than any other man in the same space of time. He began this kind of work when only thirty years old in the village of Flatbush, now a part of the city of New York, by compelling saloons to take out licenses, and closing them on Sunday, acting simply as a citizen with knowledge of the legal methods of procedure. He moved to Brooklyn when he was thirty-five and began a fight against the McLaughlin ring, then in control, which resulted in his election as justice of the Supreme Court in a contest which finally crushed the ring, and sent some of its members to prison.

After numerous refusals of the nomination for mayor of New York, he finally accepted one from Tammany four years ago and continued his reforms, introducing economies within the first three months which saved the city nearly $2,000,000 a year.

A list of seventy-four good things done under Mayor Gaynor's direction includes work in nearly every department of city government from increasing the credit or borrowing power of the city to better supervision of milk inspection.

The attempt at his assassination made

by a discharged city employe brought him the sympathy of all and would have elected him governor with no appreciable opposition if he could have been induced to accept the nomination.



WILLIAM J. GAYNOR.

He has been accused by petty politicians of all the evil things he has been fighting for so many years and the line up which was forming in the campaign this fall was based to some extent on these misrepresentations, but those who know had the strong belief that he would have been reelected if he had not been so suddenly removed from the race.

Mayor Gaynor has done his whole duty as he saw it at all times. No one is free from mistakes but no one was freer than he from intentional wrong. If every good citizen had the same courage of his convictions, politics would b eclean and city government would be a model of efficiency and economy.

George W. Fuller

The thoro manner in which George W. Fuller attacks any problem before him was first exemplified in the completeness of his preliminary technical training. After graduation from the Massachusetts Institute of Technology, in itself an evidence of a full technical education, he made a special study of sanitary science in the University of Berlin and under several eminent German specialists, returning to spend five years in the study under the Massachusetts State Board of Health of problems of sewage and water purification in its Lawrence, Mass., experimental station, in the creation of the reputation of which Mr. Fuller had a large part.

Mr. Fuller had charge of the experimental work at Cincinnati, O., and Louisville, Ky., on which were based the plans for water purification in those cities. These two investigations occupied four years.

Since that time Mr. Fuller has been in private practice and has been adviser to many municipalities, among them New York, New Haven, Paterson, Washington, Buffalo, Columbus, Indianapolis, St. Louis, New Orleans, Grand Rapids, Minneapolis, Montreal, etc., regarding water supplies and water purification, and

GEORGE W. FULLER.

many others in a number of important water works valuations and adjustments of water rates.

Mr. Fuller is in the prime of life and bids fair to add to the numerous laurels he has already gathered in his professional work.

Publications Received

Report on the Sewage Disposal System of Rochester, N. Y., by Edwin A. Fisher, city engineer. April, 1913. Cloth, 248 pp. Contains all the reports on the subject from that of Emil Knichling, dated February 1, 1907, to those of assistant city engineers, dated March 12, 1913, giving the descriptions of systems and states of contracts to that date.

Annual report of Board of Park Commissioners of Cincinnati, O., for 1912. Paper, 26 pp. Chas. H. Meeds, Park Engineer.

Bulletin of the Alumni Council of the Massachusetts Institute of Technology, Boston, Mass., giving report of the committee on a course in business engineering, and a schedule of a proposed course in engineering and business administration. Paper, 20 pp.

Annual report of the Board of Health of Harrisburg, Pa., for 1912. Paper, 39 pp. John M. J. Raunick, M. D., Health Officer.

Typical Specifications for the Fabrication and Erection of Street Highway Bridges. Paper, 25 pp. Circular No. 100 of Office of Public Roads, U. S. Department of Agriculture. Logan Waller Page, Director.

Annual report of the Department of Public Works of Chicago, Ill., for 1912. L. E. McGann, Commissioner; John Ericson, City Engineer. Cloth, 522 pp.

Eighth annual financial and departmental report of Edmonton, Alberta, Can., for year ending October 31, 1912. William Short, Mayor; A. J. Latornell, City Engineer.

Report of the Chief Engineer of the Board of Estimate and Apportionment of the City of New York, for 1912. Nelson P. Lewis, Chief Engineer.

Twentieth annual report of the Massachusetts Highway Commission, for year ending November 30, 1912. A. W. Dean, Chief Engineer.

Proceedings of the sixth annual convention of the Indiana Sanitary and Water Supply Association. Paper, 223 pp. Dr. W. F. King, Secretary, State House, Indianapolis, Ind.

Proceedings of the fifth meeting of the Illinois Water Supply Association. Paper, 275 pp. Edward Bartow, Secretary, University of Illinois, Urbana, Ill.

Regular publication of *Lefax* data sheets has been delayed by changes in organization. May and June sheets are issued in September. Forrest R. Jones, formerly professor at University of Wisconsin and Cornell University, now has charge of the editorial department. Standard Corporation, Philadelphia, Pa.

Public Utilities, their cost new and depreciation. By Hammond V. Hayes, Ph. D., Consulting Engineer. Cloth, 262 pp. $2. D. Van Nostrand Co., New York.

The Quantity Surveyor is a monthly bulletin conducted under the auspices of the American Institute of Quantity Surveyors in the interest of better methods of estimating on buildings. The organization is being formed in San Francisco with William Mooser and W. H. Ferguson as temporary president and secretary. The first bulletin was issued in August and the subscription price is $1 a year. Address secretary at 571 California street, San Francisco, Cal.

Suggested programs for guidance in the observance of Fire Prevention Day are given in a 16-page booklet to be obtained at 10 cents a copy of the National Fire Protection Association, 87 Milk street, Boston, Mass.

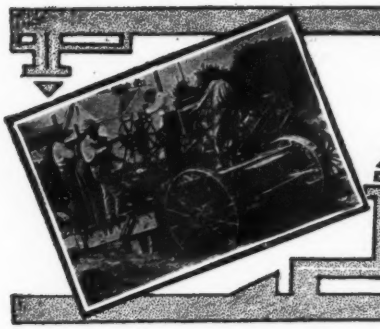
The municipal publication of Baltimore, Md., is named "The Municipal Journal." With the latest number is issued a supplement furnished by the factory site commission, giving a cycloramic photograph of the city, reproduced in a halftone plate, which is 45 inches long and 6 inches wide.

Technical Associations

A committee appointed at a summer meeting of engineers connected with various national and district technical associations has reported a plan for co-operation of the local representatives of these societies in a body to be called the "Affiliated Technical Societies of the City of Atlanta." The membership is to consist of the members of the local sections of the American Institute of Electrical Engineers, American Society of Civil Engineers, American Chemical Society, Engineering Association of the South, American Institute of Architects, and American Society of Mechanical Engineers, and of others that may be formed and admitted at any time. An executive committee composed of one member from each society will manage the organization, whose expenses will be paid by the sections and by individual subscriptions. Meetings of the association will be held quarterly. This report is now before the component sections of the proposed association for their approval and when these assents are received the first meeting of the association will be called.

The State Highway Department of Ohio held a good roads exhibit at the state fair in Columbus, September 1 to 5, with the aid of the Ohio division of the National Highways Association and the Federal Office of Public Roads. In the exhibit were included the experimental roads built some years ago on Nelson avenue and South High street in the outskirts of the city, and daily trips were made over these two roads. Lectures by experts and enthusiasts were given each day.

The little year book of the Colorado Association of Members of the American Society of Civil Engineers shows that this organization, now nearly five years old, is alive and growing. It has 68 members and the list of papers presented last year is of great value. R. W. Toll, secretary, 700 Tramway building, Denver, Colo.



MACHINERY AND SUPPLIES

Pumpage Reduced One-Half by Meters

By F. B. Wheeler, Manager City Water Co., Chillicothe, Mo.

Probably the greatest source of loss from which a water works suffers is consumer waste. This is a feature of the flat or scheduled rate method of selling water. Without the meter system, it is impossible for the water works to determine the amount of the water waste. Whether a customer takes 40,000 gallons or 100,000 gallons per annum can never be accurately known where the flat rate method is in use. Each thousand gallons of water has a fixed value to the water works, and it is readily apparent that where a flat rate is employed, the water works department is in a hopeless position when attempting to administer its finances accurately. It is evident to all who have given this subject thought and investigation that the meter system is an actual necessity in the establishment of a fair and equitable water rate. The public is content to pay a meter rate for gas and electricity which allows the concerns supplying these commodities a satisfactory profit. They are just as willing to pay a fair and equitable water rate if water departments would abandon guess-work transactions and employ accurate, up-to-date business methods, the same as apply universally in the management of commercial undertakings.

The water meter will render the same valuable service as the meters are doing which measure gas and electricity. The employment of the water meter system reduces consumer waste to a minimum.

It has been ascertained that 94 per cent. of all the municipal plants use meters on a greater or less percentage of their services, and that the same is true of 88 per cent. of the private plants. In a number of towns and cities, of course, meters are used on a few large consumers only, but when we compare the total number of services with the total number of meters, we find that 41 per cent. of all services in municipal plants are metered and that 45 per cent. of all services in private plants are metered. Private plants that use meters are using them to a greater extent than the municipal plants on the average; but the figures for the number of services added in 1912 indicate that the municipal plants will soon reverse the condition, for it has been ascertained that during the last fiscal year 95.3 per cent. of all new services added in municipal plants were metered. All water works men are, of course, aware of the rapid growth in the use of meters thruout the country, but we believe that most of them will be surprised to learn that more than 90 per cent. of all services added during the past year were provided with meters.

That meters cut down water waste is evidenced by the fact that our pumpage has been reduced by 50 per cent. since we installed the 663 Niagara meters which we now have in service. We still have 350 consumers on a flat rate basis but intend to meter our service thruout in the very near future. We are at present furnishing water to city departments and

BEARING *and pin construction of a Niagara meter.*

schools in unlimited quantities without payment, altho this is a private company. All of the meters which we have in service are of one make and were furnished us by the Buffalo Meter Company. This type of meter is, we consider, exceedingly ac-

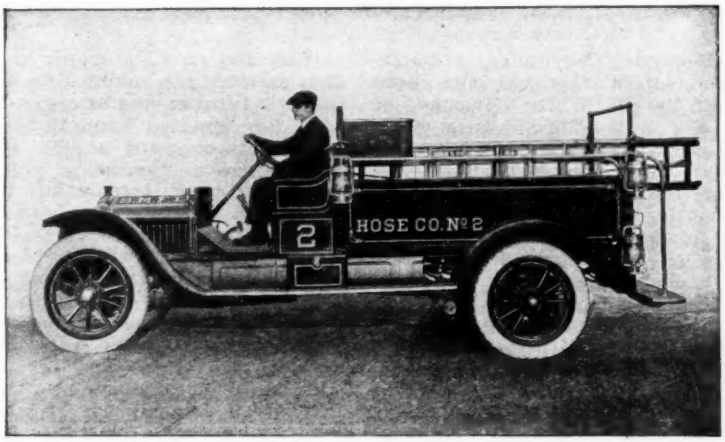
curate in registration, as the weight of the largest gear is carried on jewels which revolve on the upper ends of rigid phosphor bronze pivots, thus preventing any dirt from entering or cutting the gear bearing.

It is impossible to formulate any plan for the adjustment of rates, which would be satisfactory to every community. To enable the water department of any city to be self-sustaining, it is necessary that officials should know exactly what water costs per 1,000 gallons, so that they will be in a position to determine a fair rate at which it should be sold. The surest way to accomplish this result is by metering all the main supply pipes of the city. This plan his been tried with eminent satisfaction.

months amounted to approximately $15, whereas the cost of keeping a team of horses displaced by the White apparatus amounted to $260.

The truck equipment includes everything that is necessary to subdue fires in their early stages, and the company's experience has shown that a ready response to an alarm is often of greater value than the maximum fire fighting ability. With the White combination truck the Young America Company makes a speed of 55 miles an hour on good roads and invariably has a stream of chemical playing upon the blaze before other units of the department arrive.

The truck carries both stationary and portable chemical tanks, and the full complement of nozzles, extension ladders,



WHITE *hose truck which displaced horse-drawn apparatus, at an operation saving of* $245 *in six months.*

Motors Reduce Costs

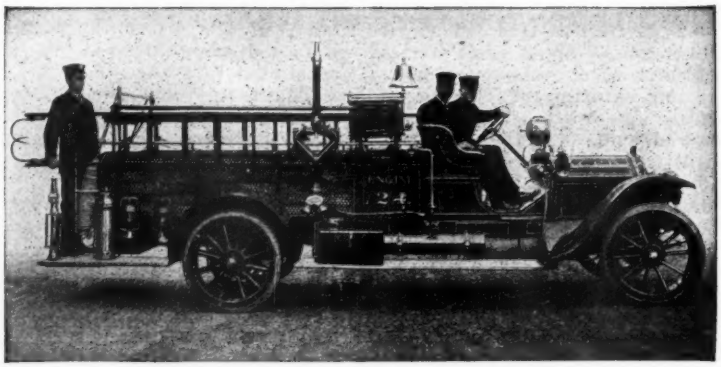
The Young America Hose Company, of Poughkeepsie, N. Y., has employed motor fire apparatus for nearly two years and the officials are firmly convinced of its superiority over horse-drawn apparatus.

In November, 1911, they placed in service a White combination chemical and hose truck, embodying the standard 1½-ton White chassis. It has answered every alarm and has been called upon to make a number of long runs to the suburban sections of Poughkeepsie. Many of the streets on which it must be driven in the city are in poor condition, particularly in the spring, and the districts from which the greater number of alarms are received are often reached only by traveling thru deep mud.

Louis A. Thompson, president of Hose Company No. 6 and chairman of committee on the purchase of fire apparatus, stated that the operative cost for six

hooks, axes, etc. The larger stationary chemical tank employs what is known as the Kanawha system in which the creation of pressure does not depend upon the usual chemical action but is accomplished by a powerful auxiliary air pressure system. On the running board of the truck there is a steel tank of compressed air with a conveniently located pressure gage. In the line from the air tank to the chemical tank there is a pressure regulating valve enabling the firemen to admit the air to the chemical in accordance with the requirements of the blaze or the consumption of the chemical. It is possible to have a stream as powerful at the end as it was in the beginning and, unlike other systems, it is not necessary to refill the chemical tank every time it is used.

The fire department of Dover, N. J., is equipped with the most modern fire apparatus both as to vehicles and the paraphernalia. The most recent installation



COMBINATION *hose and chemical truck capable of a speed of fifty-five miles per hour. Manufactured by the White Company, Cleveland, Ohio.*

was a self-starting 6-cylinder, 60-horsepower combination chemical and hose truck, built by the White Company, of Cleveland, O. It is equipped with every device or implement that has a useful place in units of this kind and is so complete in appointments, modern in design and efficient in fire fighting that it was exhibited in the last New York motor truck show as an example of the latest type of combination trucks.

Twelve hundred feet of 2½-inch hose are carried in a steel hose bed, which is quickly accessible from the rear running board. This bed occupies the conventional position between two seats running lengthwise of the truck. These seats, which are capable of seating eight firemen, have cushions that are deep and soft. Beneath each row of seats there are large lockers.

Hand chemical tanks are strapped to the running board and the large nozzles for the 2½-inch hose are carried on posts that are built on the rear running board. Hooks, lanterns, axes, etc., are carried on spring catches and hooks along the side of the body. A 50-gallon chemical tank is mounted in the customary place in a recess between the driver's seat and the hose bed, while the chemical hose, 250 feet long, is coiled in a steel basket immediately above the chemical tank.

For this class of apparatus where seconds count in getting under way, the White electrical starting system is particularly valuable. It has the unusual advantages of preventing the motor from stalling at all times and without any attention on the part of the driver. Both the functions of starting and lighting are performed by the one mechanism, the motor generator, which is mounted at the forward left side of the engine and is driven by silent chain.

Closing the switch connects the 9-cell battery and puts the motor in operation, thus starting the engine. As soon as the latter is turning over at a speed in excess of a few hundred revolutions a minute, the generator being a slow speed type, the voltage of the motor generator exceeds that of the battery, and the battery is charged at all speeds above this point, at a definite governed rate. The 18-volt storage battery is "floated" on the line in such a manner that the motor changes to a generator and back again to a motor accordingly as the electrical pressure rises or falls above or below that of the battery.

At engine speed above a certain definite point it is a generator and below that point it becomes a motor, so that should the engine stall in traffic the electric motor will automatically "pick it up" and restart it without any attention on the part of the driver. It will be apparent that this should constitute a very valuable feature of the motive power of any piece of fire apparatus where the delay incident to having to restart the motor by hand cranking might be serious.

Electrical Equipment Unharmed by Flood

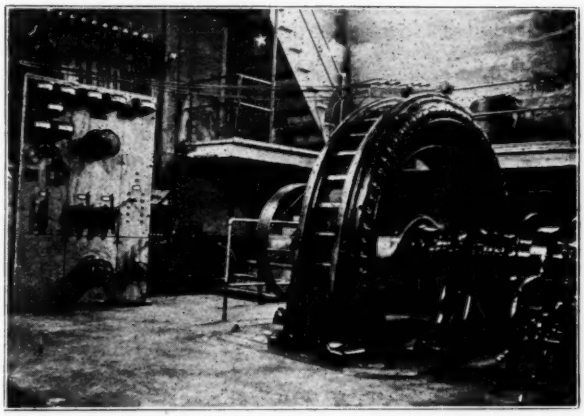
By Wm. L. Fawcett, Milwaukee, Wis.

As an example of the care and good workmanship with which present day electrical machinery is produced, and the resulting merit of present day electrical products, I have secured photographs of the effect of the flood which are extremely unusual, and which practically tell their own story.

During the spring and summer of 1910, the city of Black River Falls, Wis., in order to avail themselves of suitable water power purchased and installed an elec-

trical equipment, consisting of a 450-k.v.a., water-wheel-driven, 2,300-volt, 60-cycle, 3-phase, 200-r.p.m. alternating current generator, and a 25-k.v.a., 2,300 volt series regulator and transformer for street lighting, together with necessary switchboard for operating this apparatus, from the Fort Wayne Electrical Works, Fort Wayne, Ind.

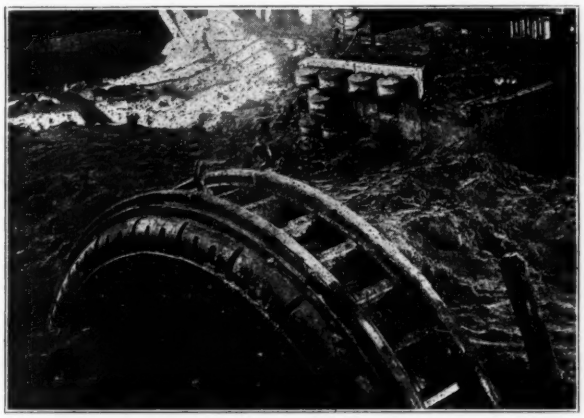
This equipment was installed in a concrete block building, erected especially for the purpose, located beside the dam which furnished the necesasry head of water. The machinery, that is electrical apparatus and water wheel, were located below the level of the ground.



VIEW *of same equipment after removal of debris shown in cut below. After thorough and careful cleaning the apparatus operated up to its original efficiency.*

During the flood, the power house, just after the dam further up the river had given way and completely overwhelmed the dam at Black River Falls, was completely inundated. It is interesting to note in this connection that the entire basement of the power house was filled with debris and sand to the level of the surrounding ground. Because of extensive damages to the dam the work of reclaiming the electrical equipment was not started for over a month, the apparatus remaining in the wet sand for that period. At that time the basement of the power house was cleared, and the generator raised about four feet from the floor to protect it from the water which drained into the basement. In the meantime the switchboard instruments, potential and current transformers, and the operating coils of the oil switches were returned to the Fort Wayne factory and put in good condition.

After about 15 months had elapsed to allow for the rebuilding of the dam, all preparations were made to again start operations. The generator was placed on a short circuit run for nearly four days and then put into operation and is operating at present and shows no effect of submersion. A peculiar incident occurred when it was decided to start street lights. The transformer which is used in connection with the Fort Wayne regulator was found to be full of water and frozen solid. A fire was built, the ice thawed, and the water removed, new oil was placed in the transformer and the outfit was placed in service and no trouble experienced. It should be noted that this transformer was filled with water for almost a year and a half.



INTERIOR *view of power house, Black River Falls, Wis., May 21, showing electrical equipment buried beneath tons of sand and other debris.*

Selection of Combination Equipment

By J. M. Donahue, Elyria Construction Co., Elyria, Ohio.

The tendency of most contractors is to buy too many pieces of equipment. Machinery deteriorates and it is an easy matter to wrap up good money in machines which can be used only for a specific purpose. Machinery when given the proper care will last longer when kept in almost constant service than when permitted to stand idle and rust. Ready cash is much better to have on hand than idle machinery. More money expended for higher grade machinery that will do more than one kind of work is the best policy.

Labor is scarce in nearly every section of the country. Wages are high. The cost of materials is increasing. Competition for contracts is keen and this makes prices low. To face these conditions, hand work must not only be eliminated in every possible instance, but only that class of machinery which will do the greatest variety of work must be purchased.

How to decide what outfit to use is often difficult. There cannot be any hard or fast rule laid down. If a man only knows of a few different machines adapted to the work, to arrive at a decision will be easy, but the chances will be that the machine selected, with its accompanying methods, will not be the most economical. In making selection of equipment, many contractors are not open-minded. They conceive the idea that a certain machine is the best suited for the work, and no matter what others say or what information is obtained showing advantages of other machines, the one originally decided upon is purchased or hired and put to work. Before any machine is selected the merits of every one that can be used should be gone into. Also every way that each machine can be worked should be considered.

Cost data on operating each are valuable, but should not be relied upon entirely to arrive at a decision, even if all costs were kept by the man to decide the question. The value of cost data is to check up the estimated cost of the work to be done. No two jobs are exactly alike, so it is never possible to use the costs of one to predict the cost of another. To do so will mean to come to grief sooner or later. Instead one must learn of the output of machines under different conditions, and then with this as a basis the cost of the proposed work, if done by the different machines, can be estimated.

The method is to list the cost of operating each machine, setting down the cost of crew, the cost of water, fuel, oil, repairs and all other items. Then the cost of serving the machine and for getting away the spoil must be listed out in detail. In getting these details of cost, both in estimating them and in checking them, is where the cost data from other jobs are useful. Many details will be similar, as the crew, the amount of fuel consumed, the cost of oil and other lubricants. With every detail of cost estimated, then the unit cost of work can be calculated per day by dividing the total cost by the estimated amount of work that can be done each day. This result must be checked up with other work if possible. To the unit costs thus obtained must be added a percentage to cover overhead charges, and another percentage to cover depreciation of machines. The total will give the unit cost if work is done the entire year, but on many classes of work in some sections of the country work must be shut down for part of the year, and as some expenses continue, this must be reckoned up and added to the cost. Some contractors then add a per cent. for contingencies, but the writer does not believe in this, as the costs should be estimated in great detail, every little item considered, and if wages are placed high and the prices of materials obtained on contracts, then the unknown quantities are eliminated, and thus contingencies are not needed. With such estimated costs for each machine that could be used on the work, it is now possible to decide in an intelligent manner the best machine to use, and this point once decided, the methods of doing the work can be mapped out. Mistakes can be made by following this mode of arriving at a decision, but they seldom occur, while it can be stated that in most cases, decided in the haphazard manner, the worst decision is made.

We have been operating, for several seasons, three Huber rollers, which we find equally adaptable for rolling, hauling and scarifying. The scarifying attachment is built to, and made a part of, the roller outfit. Nine heavy spikes, properly shaped and spaced, are attached to the front of a heavy Z-shape bar, as long as the width of the roller at the rear. This bar is connected by strong rods to the rear axle on which all the pulling strain comes. The shape of the spikes is such that as the roller travels forward they are drawn into the ground, tearing and breaking it up to a sufficient depth to leave the whole mass loose and in condition to be easily shaped up by the grader. When not in use, the spikes are carried clear of the ground and high enough that they do not interfere with the other use of the roller.

The spikes are raised and lowered by steam power. A simple cylinder is placed beneath the rear of the boiler and steam is conveyed to it by a pipe from the top of the boiler. The valve admitting steam alternately to either end of the cylinder is operated by the straight lever at the platform. As the piston travels forward or backward, motion is transmitted to the spike bar, raising or lowering it. When the scarifier is thrown down, the spikes are held in the ground by steam pressure. This gives cushioned compression. If solid rock should be encountered, the piston working against the steam will permit the spikes to raise enough to pass over, but they are forced down again immediately after passing.

The steam pressure feature assures uniform working depth of the spikes at all times, and that, no matter what the position of the roller wheels on an uneven road, the scarifier will follow the surface and tear up to same depth in low places as on high spots. Another advantage is that the surface of a street may be broken up right to a crossing, then the spikes raised and carried across and dropped down exactly at the other side, without disturbing the walk or delaying the machine. It takes but a fraction of a minute to raise or lower the scarifier, and the whole operation is controlled by the one lever. The boiler of this outfit is high mounted, and this allows plenty of room for attachment of the cylinder beneath. These combination machines were furnished us by the Huber Manufacturing Co., of Marion, Ohio.

We find the operation of this type of roller exceedingly economical, as it is sufficiently powerful not only to pull thru the hardest roadbeds, but to hold this attachment in place as well. Since the scarifier does not jump or rise to the road surface, it is not necessary to retrace the work.

Then the added tractor advantages mean a considerable saving. It is for these reasons that we favor the purchase of combination equipment in every possible instance.

Our experience shows that hauling with the Huber roller is cheaper than team hauling for the same distances, and that economy increases with the length of the haul up to the maximum. The cost per cubic yard for hauling crushed stone with this outfit is about 60 per cent. of that of team hauling for one mile, and about 40 per cent. for distances of three miles. This includes the pay of operator for the engine (who is paid straight time regardless of the condition of the weather and whether the job is running or not), the cost of fuel, and supplies for the roller and the cost of maintenance.

Prevention of Meter Freezing

The setting of water meters is one of the most important phases of water works maintenance and extension. Altho manufacturers have done all possible to improve the durability and accuracy of meters, and altho water works managers and superintendents have conducted careful experiments and tests in order to determine the types and sizes best suited to perform satisfactory service under local requirements, the matter of locating and setting meters has received little attention.

Having purchased the meters, it has been, in most departments, very largely a matter of getting them set in the supply pipes somewhere, without any special regard to the advantages to be obtained in operation, repairing, testing and reading. The location of meters has varied almost as much as the types of meter boxes used, and the manner of setting. In the warmer climates it has been very largely the practice to set meters in the sidewalks. This has been varied, however, by setting them in the street or roadway, and in front yards or lawns. In some cases they have been set in cellars or within the premises served. In the colder climates it has been very largely the practice to set them in cellars or within the premises served. This practice has been varied to some extent, however, by setting them in sidewalks and front yards, within pits with heavy cast iron frames and covers.

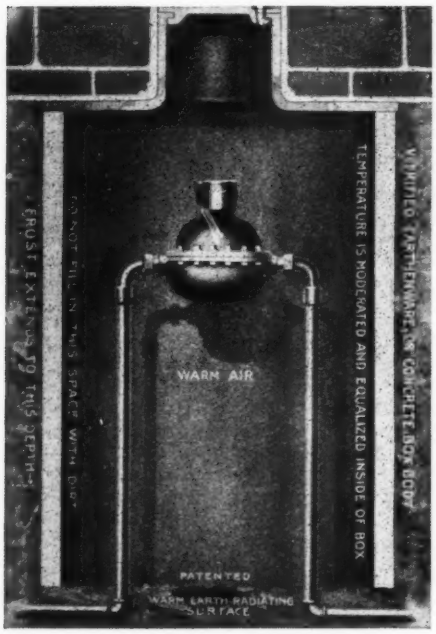
The following communication from Mr. Henry Newhall, superintendent Danvers water works, Danvers, Mass., contains an account of an interesting experiment with meter boxes:

"I was obliged in 1903 to put some of our large, from 2 to 6-inch meters, underground, and as we lost many from fire and frost, began considering placing them all so. The large ones I placed in brick or concrete pits to the full depth. This, of course, was too expensive for the smaller ones, and I experimented some until I became convinced that they could be placed much shallower and not freeze.

"I received from the H. W. Clark Co. their circular about covers, they using tile at that time for boxes. I had a sheet iron form made (afterwards getting form from them) and made a few boxes of concrete, and set meters as an experiment. I use two, 20 by 24-inch, giving a depth of 4 feet 4 inches with cover, and put the meter 20 inches to top of dial. I have never had one freeze, altho every one, including many meter works men, told me I would have no meters by spring.

"We have spells of practically zero weather running also from 10 to 20 below. We have had four winters in the past ten years when the frost has been

over five feet deep. Services, hydrants and dead ends of mains have frozen, but no meters. Our pipes have 4½ to 5 feet cover. In 1912 I had a meter close to the roadway on a sandy gravel. Six serv-



SECTIONAL *view showing setting of Clark meter box and how freezing is prevented.*

ices within 300 feet froze. The frost went in 6 feet. This meter was 18 inches below the surface. I have tested this pit with thermometer standing below zero for several days and found it 40 above at height of dial.

"I have boxes on which both salt and fresh water stand all the time and have never seen any ice, altho the top and sides of the box may be frosted. I can conceive no way to make a meter freeze unless you make a water tight pit. If you leave the bottom open to receive the warm air from the earth it cannot freeze. My experience has been that boxes with dead air spaces on top are entirely necessary.

"We have had weekly periods of severe weather when the thermometer has registered from 4 degrees below zero to 15 degrees above, but in spite of such severe tests, temperature inside meter box has registered 38 degrees above. These tests were made by resetting the thermometer dial on the meter, the pipes of which were 16½ inches below cover, which was about level with the ground.

"Our experience with the Clark type of meter box has been so successful that I feel safe in stating that no freezing of meters will result when the space below the meter and to extreme depth of the box is left open, thus aiding in the heating up of the air from the radiating surface at the bottom.

"Meter boxes of this type possess decided advantages over the ordinary box and will, under ordinary circumstances, pay for themselves within two or three years in the saving of time and expense in removing meters for testing and repairing. Several types of these boxes are equipped with stop cock, which obviates the expense of providing a separate stock the expense of providing a separate stop cock box. In cases, however, where the stop cock and service box have already been installed in the pipe lines, it would probably be advisable to use a type of box without the stop cock, unless for the sake of standardization it might be deemed advisable to do away with the old stop cock and box, and install all services with stop cock inside the meter box. These are questions that would have to be determined by local conditions.

"The question as to plumbers having access to the stop cock would also have to enter into this, as, in many cities, the plumbers are not allowed access to the meter boxes at all. Local ordinances and rules, as well as local conditions, would also have some bearing as to the advisability of location of the stop cock in the meter boxes, for the reason that in many cities the water departments merely run the supply pipes up to the curb line, and the owner of the premises must furnish the stop cock and the service box. These practices vary to such an extent that it is almost impossible to outline any general plan that would meet all of these requirements. Wherever local conditions will permit, however, the stop cock should be installed within the meter box, and access to this box should be limited absoluetely to authorized employes of the water department."

Use of Small Mixer.

"Our experience has been that a small concrete mixer is most economical for small job," states Ernest McRoberts, Malta Bend, Mo., "and it also teaches us that a number of small mixers are economical in large jobs.

"Many contractors who use large mixers on large work adopt old hand-mixing methods on small jobs, but experiments conducted on the strength of machine concrete mixed for varying periods indicate that the materials must remain in agitation with the water for at least

a full minute. The tendency to rush the work is not productive of good concrete, and should consequently be curbed. In general, machine mixing where carefully controlled is superior to hand work, since fatigue of the workmen has no influence upon the thoroughness of mixing.

"Generally speaking, wet concrete will give better results than dry, and where possible, should be used. In sidewalk and curb and gutter work, enough water should be used so that it will just flush to the top under light tamping. For roadway construction, a similar concrete is generally used for the two-course work, but for the single-course construction a wetter mixture serves the purpose better.

"For the mortar top a medium or plastic consistency is recommended. A "soupy" mixture, sometimes used, is liable to produce a poorly bonded top, and besides causing very slow hardening, has a bad effect upon the cement itself. On the other hand, a dry mixture finishes poorly and is liable to show blotches. A correct mixture will just show water on top, after being "rodded" off several times with the straight edge or template.

"With the sub-grade or sub-base properly prepared and with good materials correctly proportioned and thoroly mixed, the assembling of these in a manner which will result in a permanent structure should not be neglected. The concrete should be deposited and tamped into final position within the forms on the sub-grade or sub-base, previously wet, as quickly as possible.

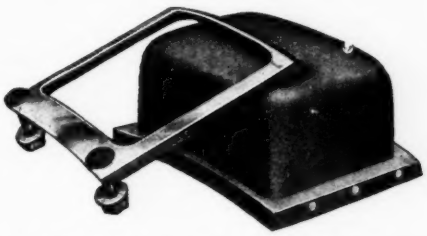
"We use a sixth-yard mixer taking two wheel barrows per batch, which is furnished us by the Jaeger Machine Co., Columbus, Ohio. This mixer weighs 1,500 pounds and has a daily capacity of 50 yards. This mixer being of medium size meets every demand of the contractor. It is not too large for the ordinary small job and yet a number of these machines on the large jobs can be operated a great deal more efficiently and economically to our way of thinking than a large mixer, requiring a large gang. Whenever too many workmen are placed in too close juxta position, some must always wait for some of the others to get out of the way. There is invariably more or less confusion and loss of time means a leakage in cost.

"This mixer is operated by 2½-h.p. Vandusen engine which can be operated by unskilled help. This mixer will turn 4 to 6 cubic feet per batch at a gasoline cost of from 3 to 4½ cents per hour. It is exceedingly simple in construction having but two discharge levers and three mixing plows in the drum.

On all medium sized jobs this type of mixer saves from $3.00 to $18.00 as compared with hand-mixing cost.

Tires for Fire Trucks

The Goodyear Tire & Rubber Company are marketing a type of individual-block fire-truck tire which is finding many warm friends among fire engineers, who claim that this type possesses many exceptional traction and non-skid features for rear wheel use on heavy apparatus. Should any one block become damaged, it can be replaced readily. Instead of having the whole tire repaired or replaced, a new block can be put on as needed from time to time, and a few blocks take the place of the extra tires usually carried. The chief advantage of the block tire is the individual feature. Each block on the Goodyear individual block tire has its own individual fastening. Thus to remove a block, it is not necessary to loosen the plate that holds a half dozen or more blocks.



SECTION *of block solid tire with frame for fastening to rim.*

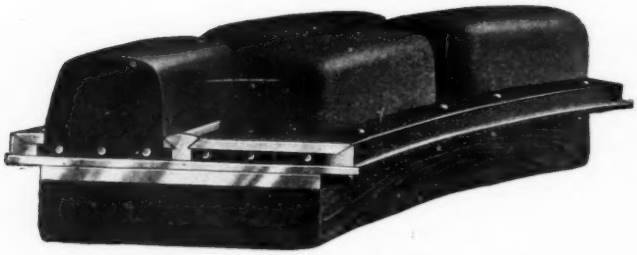
This individual fastening is in the form of a rectangular metal collar. It fits down over the base of the block. To remove the block, all attention required is but to lift the rectangular plate, and pull it from under the center ring under which it is wedged.

The Goodyear no-rim-cut non-skid tire is very popular for high-speed fire trucks, patrol wagons and ambulances where the gross weight does not exceed 10,000 pounds.

The Goodyear demountable cushion fire-truck tire has a notched dual tread, slantwise bridges, and undercut sides supported by slantwise bridges assure a resiliency almost equal to the pneumatic.

Jos. C. Millmann, secretary and treasurer Stegeman Motor Car Co., Milwaukee, Wis., makes the following report on Goodyear demountable cushion fire-truck tires as used on test of large Stegeman combination chemical and flying squadron wagon for the city of Milwaukee, October 31, 1912:

"The run was made from Milwaukee to Highland Park, Ill., and covered a distance of approximately 180 miles. Before we started back from Highland Park we had the good luck of riding in a steady



INDIVIDUAL *block tire fastened to rim.*

downpour of rain. The rain started about 10 o'clock in the morning and kept up the entire day.

"In going down we took the lake shore road, which has from 5 to 6 miles of very deep sand, the larger portion of which is not less than 6 to 8 inches deep. On our return we had to travel most of the distance on narrow country roads of poor soil with some mighty steep grades. While the test was very unusual and beyond anything the machine would be required to perform in the service, the large 6-cylinder motor did not seem to be taxed to its limit.

"We had expected to run into some difficulty on account of these poor roads, especially as we were not equipped with any anti-skid devices outside of the advantages claimed for Goodyear fire-truck tires. It was certainly a pleasant sensation to notice how these tires behaved under the conditions named. They proved themselves to be anti-skid, kept the road, and allowed us to keep up high speed. As we turned in the cities of Racine and Kenosha on the wet asphalt pavement we maintained a speed of 45 miles an hour, and took right-angle turns on the wet asphalt at a speed of 18 miles an hour without skidding. While we claim a certain amount of credit for the design of the Stegeman, in its low center of gravity and its distribution of the load over the rear wheels, we are frank to concede that the anti-skid features of the tires played a remarkable part in the test."

Motor Fire Apparatus in Manchester (N. H.)

By Charles F. Bowen.

The city of Manchester, N. H., put into service on October 1, 1910, a combination chemical and hose wagon, which cost $5,500. This was a 60-horse-power Knox machine weighing 7,750 pounds unloaded, and approximately 9,000 pounds when carrying men and equipment. The machine regularly carries 750 feet of 2½-inch water hose, 250 feet of ¾-inch canvas rubber chemical hose, one 35-gallon chemical tank, two 6-gallon chemical tanks, one 10 and one 20-foot ladder, the latter being an extension ladder, also the regular equipment of bars, plaster, hooks, axes, etc.

The company consists of a captain, lieutenant and six hose men, and is the only permanent one in the city. These are two chauffeurs, one of whom drives to still alarms and the other to bell alarms; but every man in the company does more or less of the driving, and one of the chauffeurs is changed every three or four months in order to carry out the idea. The wagon carries three signals—the regulation automobile horn, a fire bell with rope pull back of the driver's seat, and a siren whistle. The last named is not permitted on other vehicles, and is effective in clearing the streets thru the busiest section of the city. As this is the first piece of fire apparatus to reach a fire and is the only one which answers every alarm, the helmets of the chief and members of the board of fire engineers are carried on it. It is known as "Flying Squadron A."

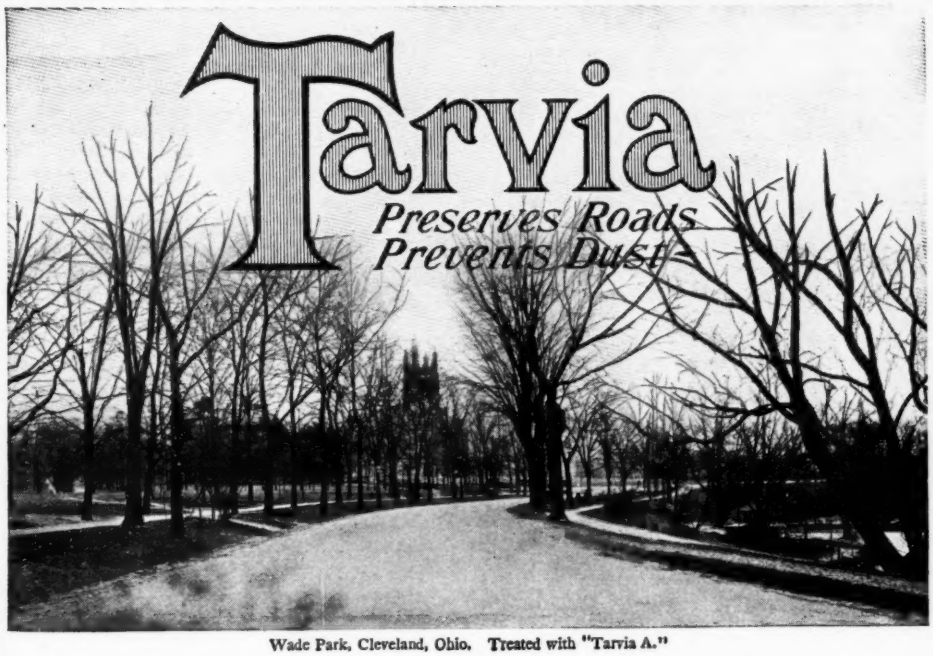
To indicate the extent of the service of this machine in a city like Manchester, with a population of over 70,000, the monthly running list is given herewith:

1910—October, 47; November, 21; December, 35.

1911—January, 41; February, 22; March, 25; April, 51; May, 36; June, 13; July, 39; August, 11; September, 20; October, 19; November, 16; December, 28.

1912—January, 62; February, 34; March, 31; April, 35; May, 37; June, 47; July, 34; August, 17; September, 13; October, 23; November, 22; December, 25.

It will be seen that the machine has been kept busy in winter time, but not so busy in summer time. As a matter of fact, however, in late summer a squad is continually out on brush and grass fires, sometimes starting out early in the morning and staying until late at night, all of which would be recorded simply as one run.



Wade Park, Cleveland, Ohio. Treated with "Tarvia A."

Cleveland's Experience with Tarvia

CLEVELAND'S experience with Tarvia has been very satisfactory. Tarvia has been used on the various roads in the parks and in the boulevard system. The following is taken from the Annual Report of the Department of Public Service.

"On the West Side, Edgewater Park and the Boulevard, the roads were treated two years ago with a surface coating of Tarvia and hence only needed a renewal coating of the same material with silica sand. This renewal cost was quite small and the results satisfactory. We would recommend a similar periodical recoating for the East Side roads about every other year.

"The results we have secured from the methods of resurfacing and repairing, as above set forth, are such that we hope the general plan may be continued on the park roads not already repaired. This form of construction offers a hard, resisting surface to traffic and thoroughly preserves the road, whereas in our opinion, the *normal disintegration of the macadam roads has heretofore been hastened by oiling.* The oil seems to be lacking in binding quality and tends to break up the macadam surface."

"Tarvia X" is a dense, viscid coal tar product of great cohesive and bonding power for pavement and road construction. "Tarvia A" and "Tarvia B" are lighter materials of the same nature for dust suppression and road preservation. "Tarvia X" and "Tarvia A" require heat for application. "Tarvia B" is applied cold. As a rule a tarviated road lasts so much longer than ordinary macadam that the cost of the Tarvia treatment is more than saved.

Booklets on Request.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Birmingham
The Paterson Mfg. Co., Ltd.—Montreal Toronto, Winnipeg, Vancouver, St. John, Halifax, Sydney, N. S.

Up to the first of this year the machine had made 1,000 runs, covering nearly 3,200 miles. It has never failed to complete a run to a fire or to be able to start out when in commission. The territory covered is about fifteen miles square, and the roads may be conservatively described as dreadful. It has been driven thru swamps in the country districts, over smoking tracts of hilly ground to get at brush fires, thru woods and narrow rural lanes and cluttered back streets, as well as the wide and smooth business thorofares. It has been driven wherever there was room to get thru without doing much damage to property, and its ability to run right up to the fire and get there promptly has been the greatest advantage and has created public confidence in the work of the squad. It is estimated that the squad, during the not quite three years, has performed work which a similar piece of apparatus, horse-drawn, would ordinarily require fifteen years for.

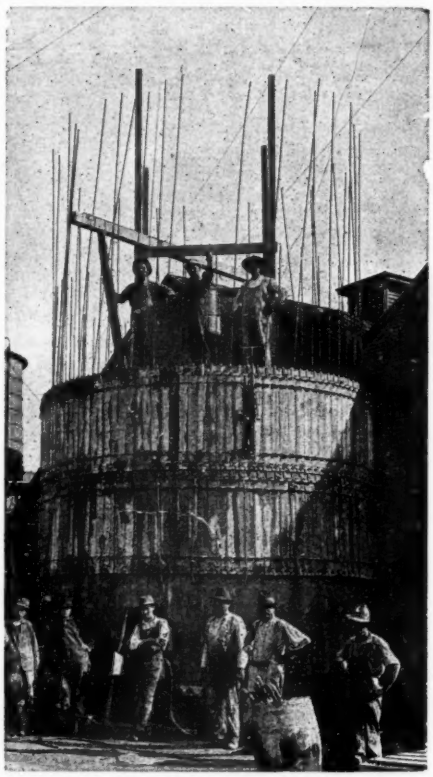
During this time two jack shafts have been broken, both as the machine was trying to start out of heavy sand into which the wheels had sunk. Once a cylinder went dry thru fault of a local adjuster. Tires have had to be changed before returning from a fire on two occasions, and six new tires have been purchased since the machine was put in service. The machine has been temporarily out of commission three times to permit of overhauling the motor, each requiring a day; twice for repairing the jack shaft, each time requiring four days; once for three days, while repairs were being made to the cylinder. While it was out of commission or when an alarm comes in while the auto is out answering another call, a two-horse chemical engine, equipped with two 60-gallon tanks, does this squad's work. But altho it is equipped with rubber tires and is drawn by fast animals, its work is not comparable with that of the motor.

There has been little tire trouble, and no extra tire is carried by the machine regularly, but when a call is made for a long distance, say five or six miles, an extra tire, already blown up, of which two are always kept at the station, is placed on the machine. Every puncture is immediately vulcanized by use of a Shaler electric vulcanizer, which is part of the station's equipment of the apparatus.

The machine can be gotten under way within ten or fifteen seconds from the time the alarm comes in. Members of the squad company answer the calls of the telephone, thereby saving one element of delay, when minutes may count up into hundreds of dollars. Illustrations of the time made are a four-mile run over an exceedingly heavy road in ten minutes and a six-mile run to a neighboring village over average country roads in thirteen minutes.

Coniform Chimney Construction

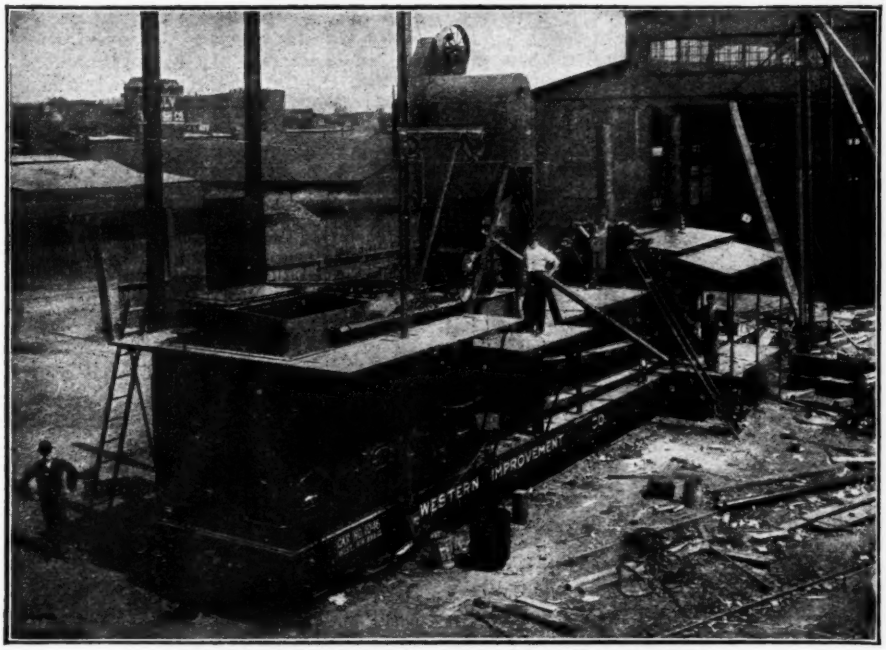
In designing a chimney the thickness of the outside shell must be sufficient to bear, with the steel imbedded in it, the pressure due to the weight of the chimney and to the wind. A proper number of vertical steel rods or bars must be inserted all around the chimney to resist the pull caused by wind pressure, and steel hoops must also be placed at inter-



METHOD *of constructing and reinforcing coniform chimney.*

vals to stiffen the vertical steel and prevent cracks due to difference in temperature between the interior and exterior, and especially to resist the vertical shear which corresponds to the horizontal shear in a beam. It is customary to assume 50 pounds per square foot of vertical surface as a maximum wind pressure; this corresponds to a wind of 100 miles per hour. It can be proved mathematically that when wind blows against the curved surface, a part of it is ineffective, so that

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

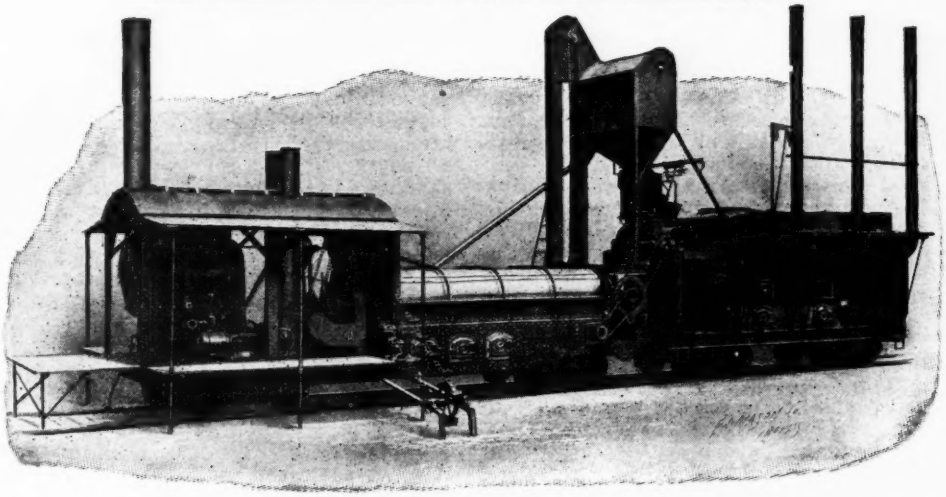
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY.



MODEL OF 1912 TWO-CAR PLANT.

the effective pressure against the chimney is not more than two-thirds the normal pressure on a vertical plane surface whose width is the diameter of the chimney. Hence, 33 pounds per square foot may be taken for the pressure against this vertical plane. If the chimney is surrounded by buildings, this would of course act only above the roof.

In designing Weber coniform chimneys, a high factor of safety is allowed and low stresses are calculated on both steel and concrete, resulting in a very conservative design. The calculations used in designing Weber coniform chimneys are based on the formula of Turneaure & Maurer (F. E. Turneaure, dean of the College of Engineering, University of Wisconsin, and E. R. Maurer, professor of mechanics, University of Wisconsin), as published in "Principles of Reinforced Concrete Construction," second edition, page 398, who are considered the highest authority on this subject. The reinforcement of Weber chimneys consists of vertical bars encircled at regular intervals by steel rings properly bent to the required circle, weight and number of these bars being entirely dependent upon the dimensions of chimney, etc. Wherever the bars connect lengthwise, a proper overlapping is given; these joinings are made very irregular, preventing, so far as possible, many joints at one height. All the tensile stresses due to wind pressure, etc., are taken up by the vertical steel reinforcement. The resistance of the concrete itself against tension is not considered in our calculations. The horizontal rings are used for the purpose of taking up wind and temperature stresses.

The Destruction of Garbage on the Premises

By Francis A. Herring, C. E., Chicago.

In the minds of many, garbage means all household refuse materials. In fact, it is only the animal and vegetable matter, the refuse food from tables and kitchens, restaurants and butcher shops. The ashes and rubbish are collected and disposed of separately. We hear but little discussion of the latter two classes of household refuse. The prominence given garbage is due to the fact that after twenty-four hours it becomes obnoxious and a menace to health.

The city ordinances of Chicago provide that garbage shall be separated by the householder from the ashes and rubbish, and shall be kept in separate cans. Theoretically, this is done. As a matter of fact, the separation is not complete. Much of the garbage is put in the can with ashes and rubbish, and while the amount may not be noticeable in a particular case, the result of the practice can be noted in no uncertain way at the open dump for ashes and rubbish, especially on hot days. Moreover, the discarded materials from sick rooms often go into the rubbish cans and in that way disease may be spread.

It is perfectly obvious that enough garbage is delivered to the open dumps about a city to make them obnoxious and unsanitary and that some remedy must be supplied. Shall a more serious attempt be made to have the garbage separated from the other refuse? Or, if it is impossible to get a perfect separation and deliver all the garbage to the reduction plant, what can be done? Shall the present plant be continued to take care of such garbage as can be obtained unmixed with other material? And shall incinerating plants be erected thru which all the ashes and rubbish of the city shall be passed in order to destroy the garbage these materials contain? Or shall all the materials be delivered unmixed in one collection and disposed of once and for all by incineration? Also shall the collections be made by wagon, steam road, street railway or boat, or by some combination thereof, or maybe all four of these means be adopted?

The answers to these questions can be given intelligently only in the light of information as to the quantity, distribution and character of the materials to be collected and disposed of. No similar undertaking is attempted in the business world without determination of such essential facts. A railway or sewer, for instance, is not built without a survey to obtain data on which to base estimates of cost and the best methods of conducting the work.

The appropriation by the city for the collection, removal and final disposal of refuse of all classes, it appears, is sufficient for these purposes if properly expended. The cost of collection is, in most cases, too high. A reduction in appropriation, however, is not recommended, as all saving effected by closer supervision should go to the betterment of the service.

From the standpoint of one who has considered the garbage question thoroly, it appears that one possible solution has been overlooked almost entirely, and that is the elimination by burning of garbage and refuse on the premises where they originate.

One of the worst features of the garbage question is the fact that it must be hauled thru the city to a far distant reduction or incinerator plant. Not only are the garbage wagons unsightly, but the foul odors coming from them are offensive to citizens and are no doubt in many cases dangerous.

Fairy Magic—Telephone Reality

A tent large enough to shelter his vast army, yet so small that he could fold it in his hand, was the gift demanded by a certain sultan of India of his son, the prince who married the fairy Pari-Banou.

It was not difficult for the fairy to produce the tent. When it was stretched out, the sultan's army conveniently encamped under it and, as the army grew, the tent extended of its own accord.

A reality more wonderful than Prince Ahmed's magic tent is the Bell Telephone. It occupies but a few square inches of space on your desk or table, and yet extends over the entire country.

When you grasp it in your hand, it is as easily possible to talk a hundred or a thousand miles away as to the nearest town or city.

In the Bell System, 7,500,000 telephones are connected and work together to take care of the telephone needs of the people of this country.

As these needs grow, and as the number of telephone users increases, the system must inevitably expand. For the Bell System must always provide a service adequate to the demands of the people.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Furthermore, from the standpoint of the home owner or the owner of the apartment building it would be wise to burn the garbage on the premises. We have too long been regarding garbage as of no value, while as a matter of fact the eagerness with which a great many reduction companies will make contracts is ample proof that garbage is of value.

Considered as fuel, engineers tell us that one ton of garbage contains as much heat giving matter as 200 pounds of coal. In other words, garbage is worth one-tenth the price of coal.

During the last few years several water heating garbage burners have been invented and these are giving satisfactory results in large and small apartment buildings, hospitals, hotels, restaurants, and in some of the larger homes. The purpose of all these devices is to make use of the garbage as fuel, water for domestic purposes being heated at the same time that the garbage is being destroyed.

Probably the garbage burner most worthy of mention is the one manufactured by the Kewanee Boiler Company, of Kewanee, Ill., and known as the Kewanee water heating garbage burner. This garbage burner is built of steel and contains a separate grate for holding the garbage and refuse. The particularly efficient part of this burner is the by-pass at the rear of the garbage chamber. This permits the fire to circulate around the moist and wet garbage, drying it to a point where it can easily be burned. There is, therefore, no possibility of the wet or moist garbage smothering the fire and the burner has proven to be not only the most sanitary method of disposing of garbage on the premises but the most economical method of heating water.

One No. 36 (type D) Kewanee water heating garbage burner as installed in a three-story, twelve-apartment building at the northwest corner of 65th and Ellis avenue, Chicago, subjected to 72 hours observation, produced the following result, showing that the cost of burning the garbage and supplying hot water to each apartment for 24 hours averaged 4 cents:

Total amount of coal used.....684 pounds
Total cost of coal.....$1.44
Total amount of water furnished.....
.....2790 gallons
Average temperature of water furnished .....155 degrees
Raised from average temperature of...
.....36 degrees..
Garbage burned.....20 bushels
Used Pocahontas coal, cost..$4.20 per ton

One No. 37 (type D) Kewanee water heating garbage burner as installed in a four-story, sixteen-apartment building, at 1047 East 47th street, Chicago, subjected to a 72-hour observation, produced the following result, showing that the cost of burning the garbage and supplying hot water to each apartment for 24 hours averaged 2.9 cents:

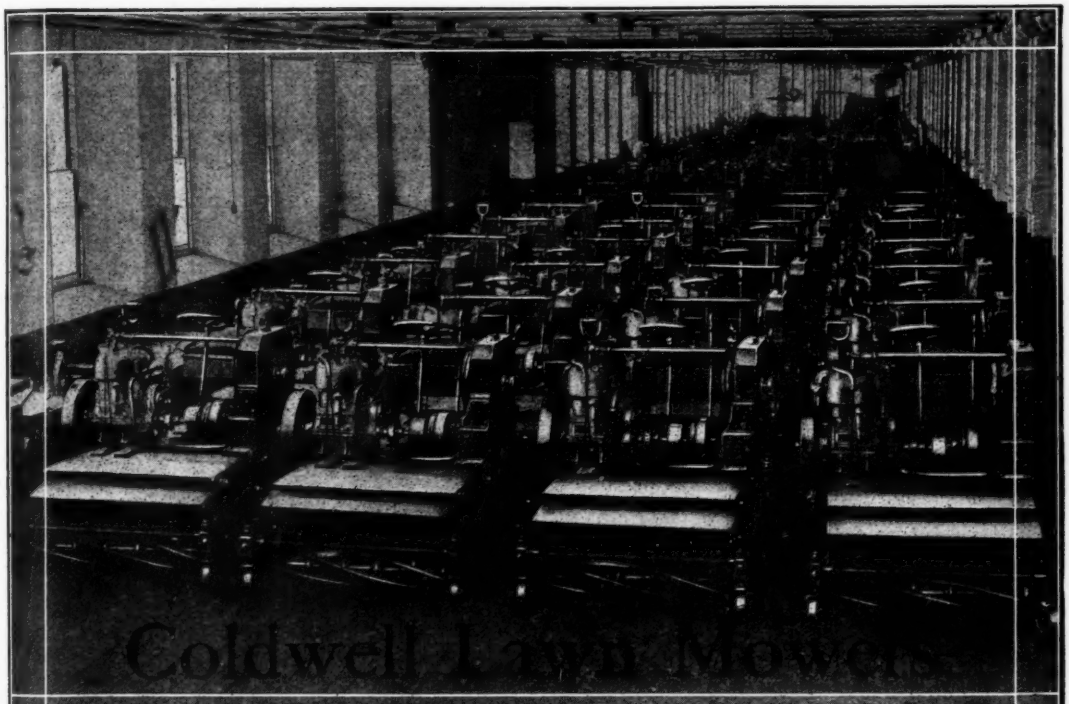
Total amount of coal used....681 pounds
Total cost of coal fired.....$1.43
Total amount of water furnished.....
.....4659 gallons
Average temperature of water used....
.....143 degrees
Raised from average temperature of...
.....36 degrees
Garbage burned.....15 bushels
Used Pocahontas coal, cost..$4.20 per ton

One No. 39 (type D) Kewanee water heating garbage burner as installed in a twenty-eight-apartment building, each apartment containing ten rooms, 280 rooms in all, at Kenmore and Lawrence avenues, subjected to one week's observation, produced the following result, showing that the cost of burning the garbage and supplying hot water to each apartment for 24 hours averaged 1.64 cents:

Total amount of coal used....219 pounds
Cost of coal used.....46 cents
Garbage burned.....33.6 bushels
Pocahontas coal used, cost..$4.20 per ton

Were an ordinance contemplated which would necessitate the installation of a device for burning the garbage by incineration on the premises where it originates, it is undoubtedly true that a storm of protest would be raised by owners of apartment buildings, hospitals, hotels, restaurants, etc., due to lack of knowledge of the value of garbage as fuel. As a matter of fact, such an ordinance would not be a hardship on anyone, but would rather be the means of saving for the apartment owner, the restaurant, hotel, hospital, etc., a sum of money from what he is now paying for the hauling away of the garbage and the heating of hot water for domestic purposes. The figures cited and these figures are fair in every sense of the word, prove this beyond any reasonable doubt. It is impossible to provide hot water at a cost anywhere near as low as the average cited where fuel for the heating of this water must be purchased. The only way this is possible is to make use of the garbage and refuse for fuel.

In other words, the passing of an ordinance demanding the installation of a satisfactory garbage burner in every building where a number of people are housed, would first eliminate entirely the garbage question by absolutely destroying the garbage on the premises before it has an opportunity of becoming obnoxious, and second, would be the means of effecting a noteworthy economy for the owner of the building in reducing the cost of his hot water supply.



Coldwell
1855

California
1915

In 1855 Thomas Coldwell built the first Lawn Mower ever made in America. The Coldwell Company has been building Lawn Mowers—better and better—ever since. That is why

Coldwell Lawn Mowers

Hand, Horse and Motor—are to be used exclusively on the grounds of the Panama-Pacific Exposition, at San Francisco, in 1915.

The managers of this great exposition wish to show the world the best that America can produce in every line.

In the Lawn Mower line they chose Coldwell from all the rest.

So, in previous years, did the managers of the Big Fairs in Chicago, St. Louis, Buffalo and elsewhere.

No other Lawn Mower on the market has ever received such high and consistent endorsement.

"Always use the BEST. The BEST is the cheapest. Coldwell Lawn Mowers are the BEST."

Made in 150 different styles and sizes to suit every need. Ask about our patent Demountable Cutters for Horse and Hand Mowers. Full Description on request, with free booklet on the practical Care of Lawns. Write today.

COLDWELL LAWN MOWER COMPANY

Philadelphia **Newburgh, N. Y.** **Chicago**

Trade Notes

The new Equitable Life Insurance building in New York, thirty-eight stories high, will contain approximately 36,000 tons of structural steel, the inspection of which, both mill and shop, has been intrusted to Robert W. Hunt & Co.

The MacArthur Concrete Pile & Foundation Co., 11 Pine street, New York, have contract covering the foundation of the new retort house and other buildings to be erected for the Mohawk Gas Co., Schenectady, N. Y., to have about 550 pedestal concrete piles. They recently completed the pile foundation for a 2,000,000 cubic foot holder. They also have a contract for the concrete pile foundations of the new Hartford, Conn., Electric Light Co. office building.

The Martin Tractor Co., of Springfield, Mass., has been incorporated with a capital stock of $350,000. C. H. Martin, vice president and general manager.

E. L. Bloomberg has been put in charge of the new branch office of the Master Builders' Company, of Cleveland, O. It is at 705 Merchants Bank building, Indianapolis, Ind.

Erie Manufacturing & Supply Company, Erie, Pa., sales agents in that locality for the Dodge Manufacturing Company, has contracted with the city for bucket elevators and screw conveyors for handling ashes from the garbage burners in the city garbage plant at Belle Valley.

The Fred Medart Manufacturing Co., makers of playground apparatus in St. Louis, Mo., whose new factory and office were partly burned in June, are now at work in their new factory and able to take care of all orders.

The Dodge Manufacturing Company, New York City, has arranged with the municipal government of that city for a 50-h.p. rope drive in the New York Geological Park. This drive will connect an oil engine with a lineshaft driving refrigerating machines and generators in the public service building. The specifications call for two 72-inch and 36-inch iron sheaves of 7 grooves each, line shafting, clutches, pulleys, hangers and self-oiling bearings. Three hundred and seventy-five feet of Dodge Firmus Manila transmission rope will be used on the drive.

D. B. Luten, Indianapolis, has received his nineteenth decree sustaining his patents on reinforced concrete arches in his suit against Boyer, Patterson & Morris at Parkersburg, W. Va.

Ceresit, manufactured by the Ceresit Waterproofing Co., 446 Commercial National Bank, Chicago, Ill., has been awarded the Grand Prix at the World's Fair, held this year at Ghent, Belgium.

Trade Publications

"A Test by Technologists" is a booklet giving expert reports on the six years of weather tests of paint for steel on the Pennsylvania railroad bridge at Havre de Grace, Md., issued by the Lowe Brothers Company, Dayton, O.

Rock, ore and gravel handling machines are fully illustrated and described in Catalog No. 252 of the T. L. Smith Co., Milwaukee, Wis. The newest things in it are the double roller chain, return track elevator and the Telsmith portable bins.

The Duryea Motor Co., Saginaw, Mich., issues a 32-page booklet crowded with "what others say" about their motors.

The circulars of the Waterloo Cement Machinery Corporation, Waterloo, Iowa, concerning their "little wonder Five" concrete mixer are very striking and convincing.

A circular of the Trussed Concrete Steel Co., Detroit, Mich., describes their new seven-rib Hy-rib in sheets 24 inches wide with ribs ⅛ inch deeper than four-rib Hyrib, giving greater stiffness and permitting wider spacing of supports.

The Orenstein-Arthur Koppel Co., Koppel, Pa., have published a detailed and illustrated description of the use of their bucket ladder excavators on the excavation of the Spanish canal from Sevilla to the Atlantic ocean.

"Everything for Blue Printing," issued by the C. F. Pease Co., 166 West Adams street, Chicago, Ill., is the only catalog issued which is devoted exclusively to this line. It fills 64 pages full.

The Pittsburg Testing Laboratory, Seventh and Bedford avenues, Pittsburg, Pa., will send, on request, a valuable booklet containing the standard specifications for portland cement, adopted by the American Society for Testing Materials; the method for testing cement of the American Society of Civil Engineers; the standard specifications for concrete reinforcement bars rolled from billets, adopted by the Association of American Steel Manufacturers; and the specifications for concrete of the Pittsburg Testing Laboratory.

The "Pedestal Pile" is a 64-page book for engineers, architects, owners and contractors, describing the pedestal concrete pile and discussing the relative merits of wooden and concrete piles of various types. It is issued by the MacArthur Concrete Pile and Foundation Co., of New York, Philadelphia and Chicago.

The Rockford railway motor cars are illustrated and described in Catalog No. 43 of the Chicago Pneumatic Tool Co., Chicago, Ill., and Bulletin 34R is devoted to Chicago pneumatic compressors.

"The Mixer" is a periodical reminder of the Koehring Machine Co., Milwaukee, Wis., that they make concrete mixers.